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EVERYTHING PNEUMATIC.

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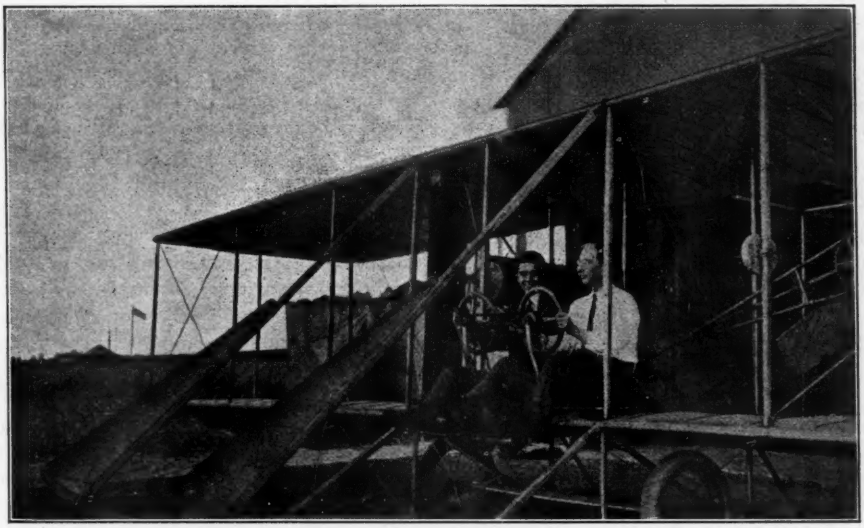


THE YOUNGEST AND THE OLDEST APPRENTICE.

AVIATION APPRENTICESHIP

The following is taken from the November issue of the Journal of the American Society of Mechanical Engineers. It narrates in the first person some of the aviation experiences of James Hartness, head of the firm, if not all of the firm, of Jones & Lamson, and an ex-President of the Society.

I consider the question of aeronautics one of vital importance to the members of our Society. It is distinctly an engineering problem. The aeroplane at the present stage needs the engineer more than anything else. I am looking forward to a great development in this direction within the next five years, and in view of the importance of the subject believe it should be kept prominently before our members.

One of the results of my experience in learning to fly has demonstrated the fact that it is possible for a man of my age to reach a point where he can handle a machine with reasonable safety. The Canadian Government does not take any men for training for war service who are over 23 years old. Some authorities think that good flyers cannot be made out of timber that is over 35 years of age, and, as a matter of record, I believe few men have learned after passing the fiftieth mark. I am, as you know, 55 years old, and I have gone

through my course at the Wright school and passed the examination for aviator's certificate which is issued under the rules of the Federation Aeronautique Internationale, with the authority of the Aero Club of America. I have had in all over 60 flights and have been intrusted with a machine without a pilot for six flights.

I became interested in the matter of flying when taking my first flight in a Zeppelin at Leipsic during our joint meeting with the Verein deutscher Ingenieure. This was followed when the opportuntiy offered by a flight in a Burgess-Duenne seaplane at Marblehead and about half a dozen flights in the Heinrich tractor at Garden City. Then I entered on a course of instruction with the Wright school which was established at Garden City last spring. The usual length of time for the regular students runs from one to two months, but my lessons were drawn out over a longer period because I spent alternating weeks at home.

I am told that the usual course of instruction in other schools begins with familiarizing the student with the working of the engine and the various controls of the aeroplane and the general behavior of the machine while on the ground. A number of runs, at first short and then longer, are taken in the machine on the ground without rising into the air. This is followed by jumps, during which the machine is allowed to rise from the ground for short distances. After that actual flights of gradually increasing duration are attempted.

But the instructor, Mr. Howard Rinehart, did not follow that method. He started the student first with a "joy ride." After that he allowed the student gradually to assume the control. The art of getting the machine off the ground and alighting was left to the latter part of the course. In my own experience, the order of my acquisition of the various elements of the art of flying might be summarized as follows:

I first gained the ability to keep the machine in lateral balance in flying straight away; then followed the use of rudder and warp for turning in a large circle; next the smaller circles in both right and left turns, making figure 8's, and during these flights, which vary from 2 to 10 min., I was permitted gradually to assume more and more of the control during the get-away. But the art of controlling the angle of climb and the art of landing were the last and the most difficult.

Barring unsteady air currents and machine troubles, the amateur's danger seems to lie chiefly in stalling in getting away and in flying, and in the general problem of landing.

The stalling is due to trying to climb too fast, for this retards the speed of the machine through the air and renders the control ineffective.

In steady air the experienced pilot is able to make his landing by swooping down and nicely leveling his course just to clear the ground, and let the wheels touch at the slowest speed at which the controls are effective.

The machine used is shown in the photograph. It is a slow-flying Wright biplane known as their Type B. It is practically the same as the Wright machine of eight years ago, with the wings warped to effect the banking and lateral control. The course was completed, however, with another machine, in which both wings were rigidly braced and flaps or ailerons were used for the lateral control.

In these machines, the dual control with instructor and student sitting side by side, the conditions seem ideal, for each may see what the other is doing. This not only makes it possible for the instructor to direct the student by prearranged signals, but it also leaves no doubt in the student's mind of the extent of control exercised by the instructor. In the machines in which the two sit in tandem position, the student is not always sure that the instructor has not gently changed the control.

The machines were driven with a 35-h. p. Wright engine. I have no accurate data as to the speed, but I understand it would get away from the ground at less than 30 miles an hour and could not fly over 45 miles an hour. This is a training biplane, different from the high-speed tractors which the Wright Company is building for other purposes. The slow-speed machines fly so close to a stall that they must be handled properly or they go wrong. A stall of the machine does not necessarily indicate a stall of the engine. It simply means that the aeroplane loses its speed in the air below a point at which the controls are effective. Then it is liable to side slip or do any one of the number of things that invite trouble.

The type of control used is a modification of the Wright system which brings it nearer

to the Deperdussin control, called "Dep" control, but the Wright does not use the foot control rudder. For lateral balance the "Dep" control uses a wheel located about the same as an automobile steering wheel, only in normal position it is vertical instead of inclined. Turning the wheel to the right or left tips the machine in similar directions. The wheel is pivoted to the frame, on which it may be moved forward and back, and this motion controls the elevator which raises or lowers the course of the machine. The Wright rudder is a lever on this hand wheel which is similar to the throttle of an automobile.

This letter may seem very elementary, especially to the aeronautical members of the Society, but in view of the newness of the art I think we should not hesitate to set forth the subject in a way to benefit those who have not entered into it.

I am sending a photograph showing the two seats of the aeroplane occupied by the youngest and oldest members of the class. Mr. Mott from Winnipeg is the younger man. He is one of the many Canadians who have come to this school to train preparatory to entering the British aviation service.

In extracting oil from peanuts in a hydraulic press they are subjected to a pressure of 6,000 pounds per square inch.

ROUGHENING A CONCRETE FLOOR FOR RESURFACING

BY CHARLES A. HIRSCHBERG

A change in plans for dry dock No. 1, Balboa terminal of the Panama Canal, necessitated the resurfacing of 113,120 sq. ft. of concrete floor. It was considered advisable to chip the floor before placing the mortar finish on the old concrete, and a more rapid means was sought than that of the hand chisel and hammer.

Two standard Ingersoll reciprocating tripod drills, air operated and of 3⅝-in. cylinder diameter, were called into use. The tripods were altered as shown in Fig. 1. At the end of each tripod leg an extension was welded, as shown at *A*, a hole being drilled at *B* to take the trunnion of the hand-made fork *C*, which carried an axle at *D*. An old pully wheel *E* was mounted on each axle.

The complete apparatus is shown in Fig. 2. The drilling machine is thrown back slightly, so that the crossbit strikes the concrete at an

FIG. 1.

angle, presenting only bit corners to the surface as the steel rotates. With each blow struck, the recoil tends to move the machine and tripod, thus materially assisting the helper in keeping the machine moving. The bits used were of the standard cross type, 8 in. in diameter. It was found that one machine, operated by two men, did as much work in 8 hours as 50 men could do by hand, and all the work was therefore performed with the two machines. Acknowledgment for the data is made to Z. T. Stagg, Jr., who was in charge of this work.—*Eng. News.*

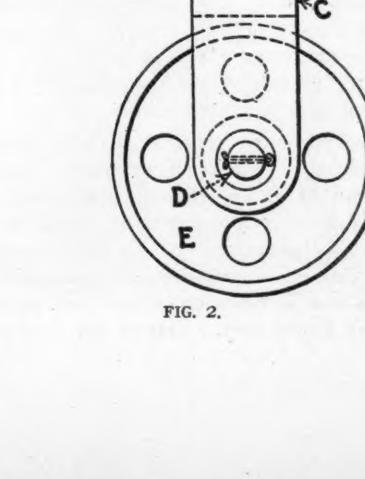


FIG. 2.

BLASTING WITH LIQUID OXYGEN IN SALT MINES

The war has advanced a type of blasting which was experimentally tried years ago, as soon almost as liquid air and oxygen became commercial articles, but which had so far not found practical adoption. Cartridges were charged with charcoal, and the carbon was impregnated with liquid oxygen; the ignited carbon then burned with explosive energy. But there were, of course, very great difficulties, which may be summed up in the statement that liquid air does not admit of being stored in closed vessels and evaporates rapidly when kept in open vessels.

In 1915 experiments with liquid oxygen cartridges were energetically taken up by the saltworks at Winterhall, acting in conjunction with the famous potassium salt mines of Stassfurt and other localities, and considerable progress has been achieved, according to an illustrated article by Dr. Heberle, of Berlin, published in the journal *Kali* of January 15 April 15, 1916. "Kali," we may add, means potash. The cartridges are simply made of texture paper, or cardboard, and are charged with soot or charcoal, mixed sometimes with other ingredients, or with kieselguhr and petroleum. The soot has answered well. A cap of fulminate of mercury is generally added for ignition; this cap should not be rigidly connected with the cartridge, to facilitate impregnation of the carbon. The Marsit cartridge does not need any cap. Ignition is by fuses or by electric wires; Dr. Hecker is said to have devised suitable ignition devices which do not require the instantaneous ignition of all the cartridges in a circuit. Impregnation of the pre-cooled material may be effected either by pouring the oxygen into the cartridge through a tube of filter paper (Baldus and Kowatsch), or by immersing the cartridge in the liquid; the latter procedure is preferable. The oxygen should be of high concentration, 99 or 97 per cent. The immersion of a cartridge takes from 5 to 25 minutes.

The experiments seem, at any rate, to have established several important facts. A cartridge can be so impregnated that it will still explode 10 or 15 minutes after being tamped in its hole; means have even been found by which cartridges could be impregnated at the surface and be taken down and used as much as three hours later. This is not considered important for salt mines, because the general conditions there demand that many appliances should be kept below. But the fact that not more than two men are required to look after up to 20 blasts would be important. Glass vessels or bottles were first tried for the transport of the liquid oxygen; but some unpleasant experiences were met with, and the transport vessels and immersion vessels are better made of metal. A hole may require 2 liters (2 quarts) of liquid oxygen. The immersion cylinders at Winterhall have a diameter of 25 centimeters (9.8 in.) and 38 centimeters (15 in.) height; but big cartridges, 32 centimeters (12.6 in.) in diameter, are sometimes used, and as many as five cartridges are fixed in one hole of a depth of 150 centimeters (59 in.) This great depth of the boreholes is characteristic of salt blasting. Heberle estimates that one blast would cost $3.50, counting materials and labor. That would not be cheap, and he adds, moreover, that conditions may be less favorable elsewhere than they are at Winterhall. The actual dearth of explosives during war time may be a factor in these attempts. But there has been a good deal of experimenting on oxygen cartridges in this country as well, of course, and the point is to adapt the extra plant to the special conditions and to utilize it fully. Sawdust, we see from another German publication on mines, has not answered well as an absorbent for oxygen in cartridges, and it was observed in a limestone quarry that the percentage of carbon monoxide present in the air went up to 0.15 after firing two of these shots. That would be a grave matter.

PNEUMATICS TO TEACH PHONETICS

The Arabic, which boasts three separate sounds resembling the English letter *h*, lacks the equivalent of the letter *p*. In consequence *p* and *b* are often confused. The late venerable Dr. Bliss of the Syrian Protestant College once entered a classroom where a native teacher was trying in vain to teach a student the difference between *p* and *b*. Dr. Bliss undertook the case. Gathering up some chalk dust in his hand and holding his hand to his lips he spoke to the student. "Do you see this dust in my hand? When I say *b* I do not expel my breath, and the chalk dust stays where it is. But when I say *p* I blow the dust all away." He did. He blew it all over the enlightened youth.

STEAM HAMMERS SHOULD BE AIR HAMMERS

The substance of the present article, both text and cuts, is adapted from the November issue of *Machinery* where it appeared under the title of "Some Notes on Steam Hammers," by James Cran, and it is here reproduced as of pertinent interest to the readers of Compressed Air Magazine because the hammers spoken of are more entitled to be driven by air than by steam, for the good of all concerned.

As a matter of fact, large numbers of what would normally be called steam hammers are now driven by air, both isolated hammers and hammers in extensive groups, as in shipbuilding establishments and elsewhere. No change in design or construction and no expense is involved in applying the air drive. It is only necessary to connect the hammer with the air supply which is maintained in practically every establishment and there is no use for an exhaust pipe. The advantages are immediate, self-evident and indisputable. The air driven hammer is always and instantly ready to go, requiring no warming up and no working off of the waters of condensation. There are no scalding drops or streams squirting around, no hot surfaces to avoid touching. The lubricant stays on the surfaces so that little is required and at infrequent intervals. There is absolutely no expense for steam or power except for actual work done and at the instant it is done. Where air is ever tried for steam hammers it stays on the job and there is no return to steam.

Two types of steam hammers [let us hereinafter call them air hammers] are in general use, namely, single- and double-frame hammers, either of which may be of the open-frame order. Open-frame hammers are not provided with guides to keep the ram and the upper die in alignment with the anvil and lower die; they have, however, a much heavier piston-rod, either of round section with one flat side to keep it from turning, or of hexagonal form working through a long gland of corresponding shape. While the alignment of open-frame hammers is not as perfect as those provided with guides, the former can be used for a much wider range of work, owing to the fact that they are accessible on three sides, having no guides to come in the way of irregular shaped forgings, and the operator has an unobstructed view of the work. The more common type of air hammer with guides is not so convenient for the majority of work, but is better suited to making duplicate parts in quantities, as special dies can be kept in almost perfect alignment.

The single-frame air hammer shown in Fig. 1 differs but slightly from most of the others of this type in general use. It is built to run automatically and the hammer will continue to strike the same force of blow as long as the air pressure remains the same after the throttle valve is opened and the controlling lever set in its quadrant. The length of stroke and the force of the blow can be increased or diminished within certain limits after the controlling lever has been set, by changing the position of the throttle lever to admit more or less air to the cylinder. The automatic attachment on air hammers performs the same function as the eccentric movement on a plain slide valve engine, opening and closing the ports that admit steam to the cylinders, the difference being that the ports of an air hammer are opened and closed by a reciprocating instead of a rotary mechanism. On the back of the ram inside the frame there is a shoe or slide upon which a cam lever attached to the fulcrum of

FIG. 1.

the controlling lever works, a short lever on the end of the fulcrum shaft being attached to the valve stem by a connecting-rod at the back of the hammer for the purpose of controlling the vertical movement of the valve.

KEEPING UP EFFICIENCY

The efficiency of this type of hammer depends to a considerable extent upon the correct setting of the valves. When the valve is adjusted so that the hammer (when running automatically) will take just sufficient air at the lower port to raise the ram, and will open the top port to its full capacity with the shortest possible travel of the valve, the hammer will work at its maximum efficiency and will hold pieces firmly between the dies by throwing the throttle wide open and setting the controlling lever at the lowest point of the quadrant. After a certain amount of service, air hammers frequently get into such a condition that they will not hold pieces firmly between the dies on account of lost motion through wear of the various working parts that connect the controlling lever with the valve stem. The reason for this is that the valve does not rise high enough to completely close the exhaust opening. The remedy for a condition such as this is to shorten the valve stem, which is adjustable, in order to compensate for wear on the connecting-rod and levers.

While most air hammers in general use are constructed to run automatically, this does not mean that all of them can be so used or without a separate operator to manipulate the valve, as only the smaller sizes, say from 250 to 600 pounds' capacity, can be run to advantage with a foot-lever connected with the throttle valve. A man doing small work can use the foot-lever without inconvenience after the controlling lever has been set for the desired force of blow, but he is obliged to have the free use of both feet when doing heavier work, and this usually calls for a wider variety of blows than can be had through a purely automatic system of control.

SIZE AND CAPACITY OF AIR HAMMERS

It is a difficult matter to state definitely the capacity of a hammer as regards the size of work which it can handle to advantage; there are so many conflicting factors which affect the situation that it is impossible to give anything like a rating that will cover all conditions. The following data, which are given out by a well-known builder of air hammers, may be safely used as a basis for estimating the size of hammer needed for a given piece of work:

Diameter of Stock (Round or Square)	Size of Hammer, Pounds
3½ inches	250 to 350
4 inches	350 to 600
4½ inches	600 to 800
5 inches	800 to 1000
6 inches	1000 to 1500

A rule given in *Machinery's* Handbook is: "Multiply the area of the piece to be forged in square inches by 80;" the result is the required falling weight in pounds. For example, a forging 4 inches square would require a falling weight of $4 \times 4 \times 80 = 1280$ pounds. This rule gives the weight considerably heavier than that recommended in the foregoing.

One of the most common mistakes made in selecting an air hammer is getting one which is too light for the work on which it is intended to be used. When a light hammer is used to draw down heavy stock to smaller size, the effect of the blows does not penetrate to the center of the material, and as a consequence the outside is drawn more than the inside. When this happens, it will be easily discernible by examining the pieces, which will be found to be concave on the end. When the hammer is of sufficient size, the ends of the pieces drawn down will be convex, showing that the effect of the blows has penetrated to the center of the work.

If it were possible to operate air hammers at all times with a full stroke and air pressure at, say, 100 pounds per square inch, it would be comparatively easy to give a rating for the different sizes, but as the variation in both air pressure and length of stroke must be taken into consideration, the problem is more difficult. It will be readily seen that when a full length stroke of the hammer can be used in working under a full head of air, the results both from momentum and air expansion are very much greater in proportion than when a short stroke is used. Some of the information given out by the manufacturers of air hammers is rather misleading to those not familiar with forging work. For example, an occasional forging may be made on a much smaller hammer than would be used for making the same piece in large quantity production. While forgings such as a 6-inch pinion or a short

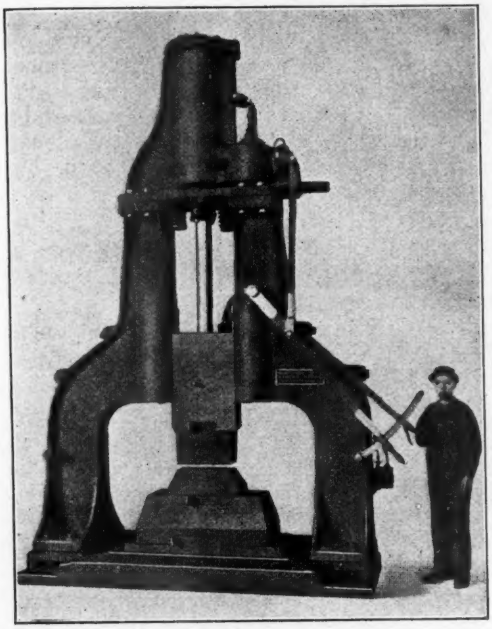


FIG. 2.

shaft can be made on an 800- or 1000-pound hammer, one of 1500-pound weight would be required to produce the same pieces in large quantities. To get the maximum output of 6-inch axles which must be forged from much heavier stock than the dimensions imply, a hammer from 6000 to 8000 pounds' capacity will be required. From the foregoing it will be seen that the selection of a hammer is dependent largely upon the work for which it is intended, and judgment must be used in regard to production and other factors mentioned.

Double-frame hammers differ from those described only in the shape of the frame, which is made in the form of an arch, the sides of which act as guides for the ram, the anvil being in the center, as will be noted by referring to Fig. 2. The open-frame air hammer shown in Fig. 3 is a machine that merits more attention than has generally been given to it, owing to the fact that hammers of this type are to be found to some extent in nearly all factories where the making of forgings forms an important part of the work.

This hammer is simple in construction, as it has fewer working parts than any other machine of the same kind. By referring to the illustration, it will be seen that it is provided with only one lever, which performs the double duty of opening the throttle and controlling the stroke. The first movement of the lever upward opens the throttle and also the lower port to the cylinder, which admits the steam to raise the ram. Thus it will be seen that the lever and ram work in unison and that when the lever is raised, the piston and ram rise, while for the downward stroke the lever is lowered, although not to the extreme end of the guide in which it travels.

A hammer of this kind cannot be operated automatically, but this is an advantage in some ways, because after a blow has been struck, the ram will not start on the return stroke until the lever has been raised. This prevents rebound and a second short stroke which often follows a full blow, delivered by hammers having an automatic attachment when attended by a poor operator. Another feature of this hammer is the absence of safety buffers which are intended to prevent the piston rising too far in the cylinder. This is taken care of automatically by a number of small ports near the top of the cylinder, which are arranged so as to admit just sufficient air to act as a cushion. The piston when raised beyond a certain point moves automatically until the air pressure under it has been released. The operation of air hammers is a knack acquired by practice, and young boys generally become the most expert in this work. Science does not enter into the operation in any way.

FOUNDATIONS

In conclusion, a little may be said in re-

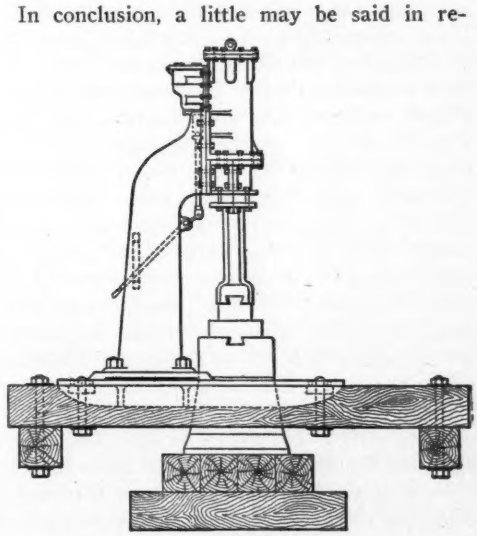


FIG. 3.

gard to foundations. While most air hammer manufacturers send out drawings and specifications to cover this part of the subject, the nature of the ground upon which the hammers are to be installed should always be taken into consideration. In sand or clay soil it is advisable to have the foundation of concrete up to within 6 inches of the anvil base and covered with a wooden cushion to bring it up to its full height. When a rock bottom is found, the pier of crossed timbers usually specified will give satisfaction.

"GASSED" IN THE TRENCHES

This is what "gassing" is like. The description is by one who knows what it is from practical experience. "In the morning I was listening in the gallery that had been blown on the Friday, and as it had been pretty free from gas I never took a canary to test the atmosphere. I must have been down about three-quarters of an hour when one of my men joined me, and in about another quarter of an hour we came up. Directly I came to the fresh air I felt rotten, and said to my man, 'Air is very bad.' 'Yes,' he said, 'I don't know how you stood it so long, sir.' I got back to my dug-out and was very sick, but B—— thought I was only bilious. I had to survey a point in two shafts in the afternoon, and went out in a half-fuddled state to do it. I know I went down the gassy shaft and another, and I just remember getting back to my dug-out and again being very sick. B—— still thought I was bilious, and by that time I was incapable of telling him that I was gassed, but fortunately our reliefs came in at 5, and one of the officers saw what was the matter, and put me straight on to a stretcher, sending me off to a dressing station. By that time I was 'out,' and dimly remember being mauled about and told to 'Breathe, you old fool, breathe!' I remember protesting that I was quite happy, but under pressure tried to heave up my chest and take a breath. It's a most pleasant sensation, really, and there is no pain at all. Only they would annoy me by sticking evil-smelling things to my nose and mouth. Ulitmately they pulled me round, and sent me off to the second dressing station, and thence to rest camp, hospital and 'Blighty,' much against my will. To show you how bad the gas was at that part, when our company was handed over to another one, a few days before I got this time, they, of course, carefully explained how bad the place was for CO gas, and were rather laughed at for their trouble. But two nights after they took over, they lost one officer and five men, not through an explosion, but through breaking into a 'pocket' which still held gas from an old explosion."

AMERICAN ENGINEERS SINKING A SHAFT IN NORWAY

BY LLOYD D. COOPER*

At the Lökken mine, operated by the Orkla Grube-Aktiebolag, Norway, to increase the output a shaft was to be sunk to the depth of 1,200 feet, and a depth of 85 feet was reached by the Orkla company when a contract was closed with the E. J. Longyear Co., of Minneapolis, Minn., for the completion of the work.

Under this contract it was agreed to maintain an average rate of 66 ft. per month. The crew for the work was secured on the Marquette and Menominee ranges in Michigan and reached Lökkens Verk early in July, 1915. Shaft sinking, however, was not started until Aug. 5.

The Orkla company had installed a surface plant for the shaft-sinking operations. This consisted of one motor-driven Ingersoll two-stage air compressor, one motor-driven Hammer single-stage air compressor, two motor-driven hoisting engines having a hoisting speed of 300 ft. per min., and a 7½-h. p. Sturtevant ventilating fan. This equipment was used by the Longyear company in the consummation of its contract, with the addition of a No. 5 Leyner drill sharpener, which was brought over from America. The drilling equipment consists of 15 BCR430 jackhamers with 30 sets of ⅞-in. four-point steel.

The shaft is 12x18 ft. outside of timbers, divided into five compartments which will provide for two skips, two cages and the necessary pipes and ladderways. The rock through which the shaft has been sunk is known as gabbro. It drills easily except through seams of low-grade ore, which occur frequently.

Temporary sheaves are supported on timbers set in the concrete foundations for the shafthouse, which itself will be built of reinforced concrete, as well as the machine shop

*Chief Engineer and later Manager for E. J. Longyear Co. at Trondhjem, Norway.

and engine house which are at present under construction. The spoil is hoisted in two 30-cu. ft. buckets, guided by crossheads and is used for filling a railroad grade about 1,000 ft. from the shaft.

The water encountered is handled by one Eureka 10x4½x10-in. outside-packed plunger pump on the 200-m. level and one 7x3-in. piston pump which is carried down on the timbers as the shaft is sunk. A small pump is used in the bottom, and all pumps are driven by air. A large sump on the 200-m. level was made by building a concrete wall across the drift, and most of the water that comes into the shaft above this level is caught by it. It was planned to pump from the 290-m. level with an electrically driven vertical centrifugal pump capable of handling 135 gal. per min. to a height of 650 ft., but this was found unsuitable and was replaced by an air pump.

The air compressors were of sufficient capacity to maintain 90 lb. pressure, but an unusually early winter caused a serious shortage of water at the power plant just at the time when it became necessary to pump with air, so that from December, 1915, until March, 1916, pressures of from 55 to 80 lb. prevailed. At times only four drills could be used while the pumps were running. As the depth from which the water had to be pumped increased, it was found necessary to run an air line to the compressors at the Lökken mine and use additional compressed air from there. The air line in the shaft is a 4-in. pipe, to which is attached a header with twelve ¾-in. nipples for the machine and pump-hose connections.

The work has been carried on in three 8-hr. shifts with an average for the year of 8.5 men per shift. The personnel is under the supervision of a mining captain and consists of the following men working an 8-hr. shift: 3 foremen, 30 miners, 1 timber foreman and 4 timbermen. The following worked a 10-hr. shift: 2 timber framers, 2 blacksmiths, 2 pipemen and 1 electrician. In addition, the following worked a 12-hr. shift: 2 pumpmen, 3 hoisting engineers, 2 compressor men and 9 landers.

THE METHOD OF WORKING

The first 260 ft. of the shaft was supported with round timbers spaced 7 ft. apart without lining. Soft ground was encountered which made it necessary to change the method of timbering, and 7x7-ft. square sets, spaced 6 ft. on center and supported on timber bearings at 100-ft. intervals have been used. The shaft is lined with 3-in. plank, and the skip roads are separated from the rest of the shaft with 3-in matched lumber. All timbering, with the exception of putting in the stringers, is done without interfering with the sinking operations.

A strong timber stage, having doors through which the buckets pass, is hung below the bottom set, and on this the timbermen work. This stage is supported by four wire cables wound on hand winches in the tunnel

and is lowered as the stage is sunk. The skip-roads are covered at the tunnel level by two pairs of doors, balanced with counter-weights, which are closed after the bucket is hoisted, preventing any rock from falling back into the shaft.

Under the usual arrangement of drilling, which of course was varied somewhat as the character of the ground changed, 14 sink holes were drilled and with them were blasted the four corner holes from the last round above, using du Pont delay electric exploders. After the rock from this blast had been hoitsed, 46 squaring-up holes were drilled, the inside holes being started down in the sink. The holes were found to break deeper when drilled in this way, and it more than compensated for the extra time taken in drilling the round in two parts. On the second blast 15 to 20 holes were shot and the mucking continued until water appeared in the bottom of the shaft. The remaining holes, with the exception of the four corner ones, were then blasted so that the pump was not taken down until after the last blast.

After blasting, the smoke was drawn out through a 10-in. pipe. This method required from 30 to 40 min. to clear the shaft so that work could be resumed.

THE RATE OF PROGRESS

During the year of sinking from Aug. 5, 1915, to Aug. 4, 1916, the cuts averaged 5.7 ft. in depth, breaking 1,231 cu. ft. of rock each with 494 lin. ft. of drilling. The average drilling speed was 4.4 ft. per machine-hour, which includes all the time from the completion of the mucking until starting to charge the holes. The 14 sink holes are frequently drilled by 10 machines in one hour. The holes averaged 7.6 ft. in depth. Of the actual working time in the shaft, 30% was spent in drilling, 59% in mucking and hoisting and 11% in blasting.

During this period the miners worked 7,217 shifts removing 206,496 cu. ft. of rock, or 28.6 cu. ft. per man per shift. In this time the shaft was sunk 904 ft., or at the rate of 75.3 ft. per month. As the shaft had previously been sunk 85 ft. by the Orkla company, the total depth on Aug. 4, 1916, was 989 ft. In connection with the sinking, stations were cut at the 200-m. and 300-m. levels, requiring 49 shifts of 8 hr. each; in October, 1915, the compressor house was destroyed by fire, causing a loss of 38 shifts, while labor troubles in May and June delayed the work 30 shifts. The actual sinking time (making no allowance for delays) was therefore 276 days, or a sinking rate of 85.3 ft. per month.

As the Norwegian laws prohibit Sunday work, requiring a suspension of 28 hr., no work was done from 6 p. m. on Saturdays until 10 p. m. on Sundays. In the spring of 1916, however, permission was obtained to work until 11 p. m. Saturdays, thus permitting all the men to work six full shifts a week.

At the date of writing (Aug. 22, 1916) there still remained approximately 210 ft. of shaft to be sunk and two stations to be cut.

The following permanent equipment is to be installed when the shaft is completed: Two 500-h. p. Hammer air compressors, direct-connected to 300-kw. motors (each compressor will have a capacity of 2,600 cu. ft. per min.); one hoisting engine for men and materials, having a 10-ft. drum with a speed of 1,200 ft. per min. and driven by a 280-h. p. motor; one hoisting engine operating two 5-ton skips at a maximum speed of 1,450 ft. per min. and driven by a 700-h. p. motor. (Both hoists will have automatic speed-regulating devices attached to the indicators to prevent overwinding or excessive speed at the start); one electrically driven plunger pump handling 135 gal. of water per min. to a height of 1,200 ft.; one 30-h. p. ventilating fan; two 36x42 Buchanan rock crushers, which will be installed underground. —*Eng. and Min. Journal* (Abridged).

GASOLINE CAUTIONS

Gasoline should be kept and used only in small quantities, and used only by experienced employees who realize the danger in using this volatile fluid and know how to handle it safely. Gasoline should be handled in small safety cans, equipped with safety gauze and safety stopper. Gasoline is exceedingly volatile and will vaporize when exposed to the air at any temperature down to 15 below zero. This vapor is nearly three times as heavy as air, and when mixed with the proper quantity of air becomes violently explosive. The vapor will ignite from any open flame, even from a spark of static electricity from a human body, a spark from an emery wheel, or from a sufficiently heated surface. The gasoline vapor, being heavier than air, will naturally seek a lower level, and if confined where there is poor ventilation, will sometimes remain in an explosive condition for months.

AIR-BALANCED HOISTING ENGINE

[The title above which we here reproduce with an interesting article from a recent issue of *Power*, must strike the reader as not adequately descriptive of the matter as a whole. It will be seen that the compressing of air not only balances the descending skip but the air so compressed is put to economical use in connection with the steam employed for hoisting. The arrangement is ingenious, but there are those who will question whether all the additional apparatus required and the complication of function may not "cost all that it comes to."]

At the Franklin Junior copper mine of the Franklin Mining Co., at Boston, Mich., is a combined steam and air hoist for handling the skip in the single shaft that is 3,700 ft. deep. Usually a double-compartment shaft is used at copper mines with two skips, one being at the top when the other is at the bottom of the shaft, and each counterbalances the other. It is the opinion of some that a single-compartment shaft on long lifts is advisable, but in order to operate a single-shaft hoist economically some kind of balanced hoisting engine must be used. Although this air-balanced hoisting engine is more complicated than the ordinary type, it utilizes the power developed by the descending skip by using air that is compressed during such periods.

The hoist is a horizontal, twin steam-cylinder engine. Both steam cylinders have Corliss valves and are next to the crossheads. The air-compressor cylinders are immediately back of the steam cylinders. Extension piston rods pass through the head end of the steam cylinders, to which the air pistons are attached, thus forming a combined hoisting engine and air compressor.

While lowering the skip, the piston in the steam cylinders runs free, the weight of the skip (1,400 lb.) and the cable being sufficient to rotate the hoisting drum and operate the compressor pistons. While hoisting, the air pistons run free. Full control of the hoist is afforded by means of suitable levers convenient for handling by the engineer, who operates from an elevated platform. As the skip descends the shaft, its speed is governed by the engineer, who controls the amount of air compressed, and he can govern the work performed in the air cylinders between the limits of no load and full cylinder capacity.

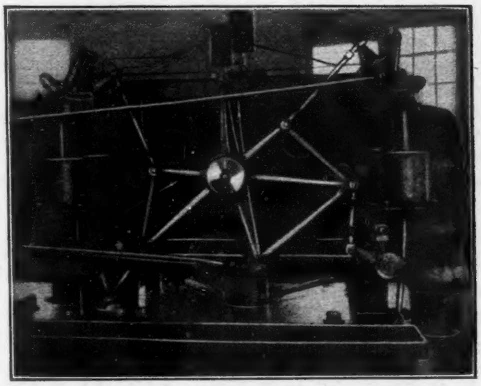


FIG. I.

The air-compressing cylinders (Fig. 1) are each designed with four valves of the Corliss type. Both bottom valves admit free air to the cylinder; the two upper ones are for regulating the air capacity and are controlled by the engineer while lowering the skip. Both are fitted with releasing mechanism and dashpots. In the heads of the compressor cylinders are spring-loaded discharge valves through which the air is delivered under pressure. When the two upper valves are open, the passage from the cylinder is direct to the air-inlet pipes through a chamber on top of the cylinder, and no air can be compressed.

The operation of these valves is as follows: When the skip is being lowered and the air piston is moving toward the end of the cylinder, if the regulating or top valve is open, the air in front of the piston will be forced back into the inlet pipe. Should the engineer trip the valve at any point of the skip travel in the shaft, the dashpot will close and the air left in the cylinder will begin to compress until a pressure is reached sufficient to open the discharge valve, when it passes to the storage tanks.

The farther the engineer moves his lever the more air will be compressed and the resistance on the air pistons will be increased. In this way the air cylinders regulate the speed of the hoist while lowering the skip. Ordinary steam-operated brakes are used for controlling the speed for the landing of the skip. On the steam cylinders the exhaust valves are arranged to be released from their connections and remain wide open and stationary so as to enable the engine to run free while lowering the skip. Upon reversing the direction of

rotation for hoisting, they are hooked up again. This releasing and hooking-up mechanism is operated by a small steam-thrust cylinder. As the operating gears of the cylinders are connected to the reversing gear of the hoisting engine, the exhaust valves are either released or hooked up as the case may be, when the engineer reverses the engine, without any other attention on his part.

All air compressed by the machine is mixed with the steam from the boilers, and the mixture is used in the steam cylinders of the hoist during the hoisting period. The mixture takes place in three cylindrical drums, each 10 ft. in diameter and 32 ft. long. As shown in the plan view (Fig. 2), a 12-in. steam pipe runs from the three 200- h. p. locomotive-type boilers to one end of the receivers. From the opposite end of the receivers a 16-in. pipe is run to the throttle valve of the engine. There is also a 12-in. discharge pipe from each air compressor, which connects with the 16-in. line that carries the air to the receivers while lowering the skip and air and steam to the steam cylinders while hoisting. In the 12-in. pipe between the boilers (which carry 125-lb. pressure) and the receiver tanks, there is a reducing valve set to maintain about 65 lb. pressure on the receivers.

The operation of the receivers, tank and reducing valve is such that when the skip is at the top the receivers are under a steam pressure of, say, 65 lb., and when it is lowered into the mine the air compressors begin to discharge compressed air in to the receivers, where the air is mixed with the steam which they already contain. This pressure increases until by the time the skip reaches the bottom of the mine it is 95 lb. in the receivers. When starting to hoist, the pressure gradually decreases until 65 lb. is reached as the engine uses up the stored air produced by the lowering of the skip. When this pressure is reached in the receivers, the reducing valve opens and steam from the boilers goes to the engine to complete the remainder of the hoisting travel. When the hoist stops, the pressure in the tank is built up to 65 lb., and upon the next lowering of the skip the operation is repeated. The skip is hoisted about 1,000 ft. with air pressure and the remaining distance with steam.

The general dimensions of the hoist are as follows:

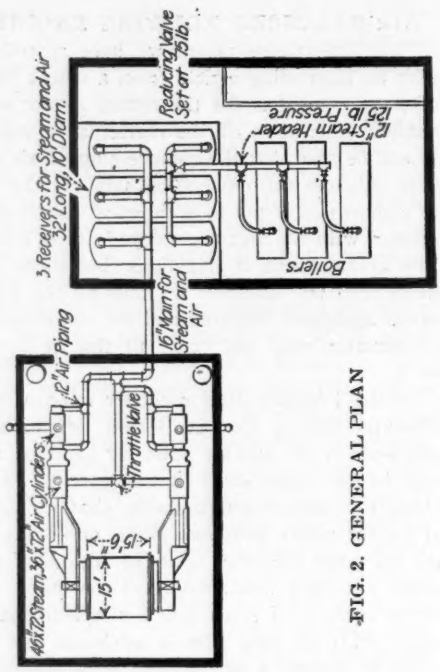


FIG. 2. GENERAL PLAN

Diameter of steam cylinders	46 in.
Diameters of air cylinders	36 in.
Stroke of all cylinders	72 in.
Diameter of piston rods	7½ in.
Diameter of hoisting drum	15 ft.
Length of hoisting drum	15 ft. 5 in.
Capacity of drum, rope	5,130 ft. 1⅝ in.
Weight of skip	14,000 lb.
Weight of rock	20,000 lb.
Velocity of skip hoisting	1,500 ft. per min.
Velocity of skip lowering	2,000 ft. per min.
Shaft dip	47 deg. from horizontal

Only three levers are required to handle this hoist—a throttle, a reversing and a brake lever, the same as on other types of hoists. In this instance, however, the throttle lever usually stands in a vertical position when the hoist is stopped. If the engineer pushes it from him, it operates the throttle valve; if he pulls it toward him, it acts on the regulating valves of the air cylinders.

The idea of using this type of hoisting engine originated with R. M. Edwards, general manager of the Franklin Mining Co., of the Lake Superior copper district, and it was built by the Nordberg Mfg. Co.

POWER FROM VOLCANIC HEAT

The greatly increased cost of coal in Italy has stimulated the search for other and more economical sources of energy. A novel method of obtaining power consists in the utilisation of the internal heat of the earth in a volcanic district. A thermo-electric power-house is already in operation at Larderello, some twelve miles from Volterra, and producing about 10,000 h. p. The idea of using the available heat was first put into practice by Prince Ginori Conti in 1903. At Larderello steam issues from the earth in jets, and the Prince first utilised the steam as a jet impinging on a bucket wheel. Later he used the steam in the ordinary way in a reciprocating engine coupled to a dynamo. Encouraged by the results, he made use of a small part of the steam issuing from one of the largest jets at a pressure of 75 lbs. per sq. in., and by this means obtained some 40 h. p. The steam from this jet issues at a temperature of 160 deg. C., (320 F.) and at the rate of 11,000 lbs. per hour. The general results obtained were quite satisfactory, except that it was found that acids present in the steam rapidly corroded the engine. In the meantime, while these experiments were going on, borings were made to discover new sources of steam, some of which gave good results, especially one which gave out steam at a pressure of 30 to 45 lbs., and at the rate of 55,000 lbs. per hour. In 1912 a turbo-alternator of 300 h. p. was installed, and was used to light the borax works at Larderello. Matters were at this stage when the war broke out, and the immensely increased cost of coal (now quoted at $50 per ton) gave an impetus to further development. The Prince decided to make a great step forward. The well-known engine builders, Messrs. Tosi, of Legnano, are now providing three steam turbines each of 5,000 h. p., coupled to alternators of 3,000 kw. The turbines are provided with surface condensers. The natural steam, however, instead of being used directly in the turbines, is used to heat multitubular boilers giving a pressure of 23 lbs. per sq. in. Two of these 5,000-h. p. groups are already installed and in operation, and the third will shortly be added. The current is transformed up to 36,000 volts and transmitted along five different lines to the towns in the neighborhood.

COST OF OPERATING AIR COMPRESSORS FOR RAILWAY TRAINS

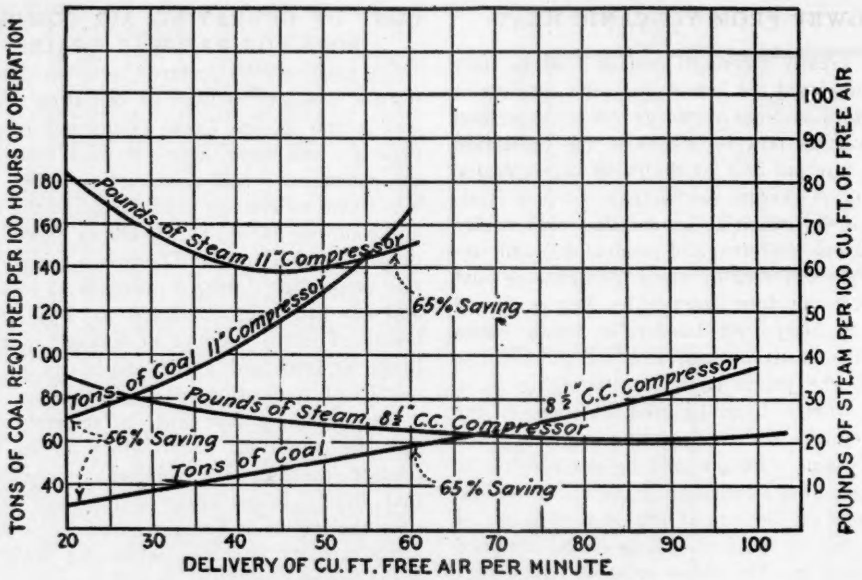
We have recently received inquiries concerning the comparative cost of operating the 9½ and 11 and 8½ ins. Cross Compound air compressors, and these questions were relative to the comparative coal consumption under what was stated as average conditions, and the average condition would be something exceedingly difficult to determine. There is a wide variation among the different railroads as to steam and air pressures employed as well as the length of trains, amount of leakage from the brake system, and grade conditions or frequency of applications of the brakes.

Another thing that must be remembered is that the conditions under which an air compressor operates are somewhat peculiar in that there are no brake applications at the time the engine is being worked to its maximum capacity and that when the brake applications are made the engine throttle is shut off and some of the steam consumed by the air compressors would otherwise be wasted through the safety valves, that is, there is a possibility of such being the case.

Another phase of the situation is that it is impossible to work up any accurate statements for average conditions, since the amount of water that will be evaporated per pound of coal varies widely according to the type of coal used, some coal will evaporate approximately 5 lbs. of water per pound of coal while other grades of coal will evaporate from 10 to 11 lbs. of water per pound of coal.

As a comparison of the amount of steam consumed by the three different types of compressors for doing an equivalent amount of work or delivering an equal number of cubic feet of free air for a specified length of time, when operating against 100 lbs. air pressure with 200 lbs. steam pressure, the 9½-in. compressor consumes approximately 68 lbs. of steam per 100 cubic feet of free air delivered, while the 11-in. compressor 65 lbs. and the 8½-in. cross compound 24 lbs. per hundred cubic feet of free air delivered.

From estimates that have been made covering the actual cost of operation of air compressors in steam railroad service, it appears that the cost of operating the 9½-in. compressor is about 185% more per hundred cubic feet of free air delivered than the 8½-in. compressor. However, the cost in dollars and



COMPARATIVE STEAM AND COAL CURVES.

For various rates of air delivery of the 11" x 11" x 12" and the 8½" C. C. compressors at 185 lb. steam pressure and 110 lb. air pressure. Compressor speed controlled by 1¼" governor set at 110 lbs. Coal required computed on the basis of 7 pounds of water evaporated per pound of coal and 1,000 hours continuous service.

Example: At 50 cu. ft. free air per minute 11" compressor uses 129 tons of coal and 8½" C. C. compressor uses 52 tons of coal. 129 — 52 = 77 tons saving. 77/129 = .60 or 60% savings.

cents would depend upon the various conditions mentioned.

There is a considerable amount of information given in a paper read before the International Railway Fuel Association, at Chicago, Ill., last May, in which the cost of air compressor operation was dealt with, but this was mostly from a viewpoint of cost of brake pipe leakage, and it certainly emphasizes the importance of the elimination, so far as possible, of brake pipe leakage from a standpoint of economy in coal consumption, saying nothing whatever of the possibilities from improved brake operation.

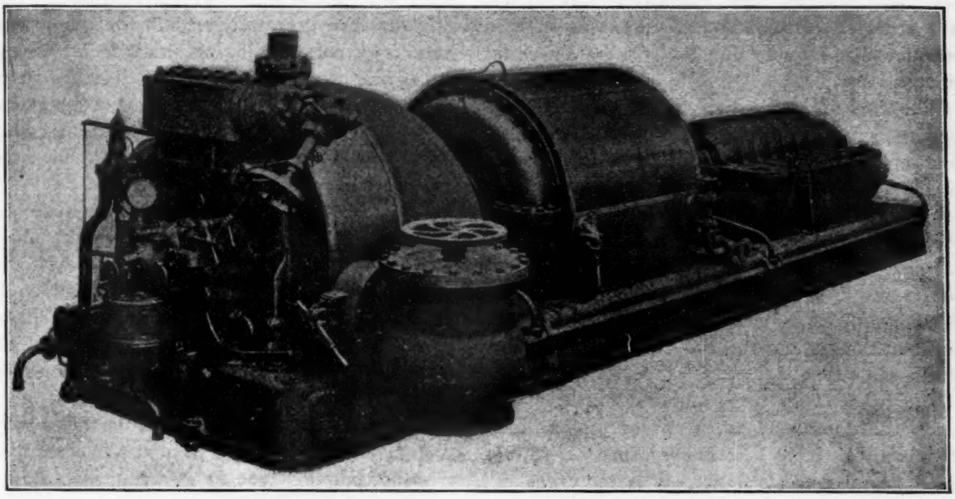
On a 100-car train, an 8 lb. per minute leakage from the brake pipe is assumed, and with such a train 3,621 lbs. of coal will be consumed during a trip of 12 hours duration through brake pipe leakage alone. From tests made with trains averaging 68 cars, two 11-in. compressors in average condition, it was found that the coal consumed by the compressors was 7,500 lbs. per trip of 115 miles made in 13 hours.

From another point of view, the cost of train pipe leakage in fuel with compound pumps, it was found that this would fluctuate around .00015 cents per car mile, or 15 cents per thousand car miles. On one particular road, the total car mileage, freight, passenger and work train, was 798,607,253 which at 15 cents per thousand car miles means an expenditure of $119,791 per year to maintain brake pipe leakage.

As a comparative cost of the different compressors in this operation, it was found that for the same amount of work in maintaining brake pipe leakage, the cost with the 11-in. compressor would be $299,477 per year, and with the 9½-in. compressor the cost would be $359,373.

The diagram shown here, obtained from tests made by the Engineering Department of the Westinghouse Air Brake Company, shows a comparison of the amount of steam and coal consumed by the 11-in. and 8½-in. for a given amount of work per hour. That is, it is intended to demonstrate the economy in coal consumption that is made possible by the use of the cross compound compressor which uses the steam from the high pressure cylinder into the low pressure cylinder for work before it is exhausted to the atmosphere or rather uses

the steam twice, as is meant by the expression compounding. With the cross compound air compressor, however, compressed air is also utilized to assist to a certain extent in the operation of the compressor, that is, in the final stage of compression, air compressed from the low pressure air cylinder assists in the operation of the low pressure steam a high pressure air piston.—*Railway and Locomotive Engineering.*



HIGH PRESSURE TURBO AIR COMPRESSOR.

HIGH PRESSURE TURBO AIR COMPRESSORS

Turbo-compressors supply an interesting example of the rapidity with which in modern machine construction any new type of machine is brought from the initial stages to a practical and serviceable form. The turbo-compressor, which is to-day constructed in single units of the largest output, has been developed within a period of about ten years. Compressors of this type have been built in sizes ranging up to 60,000 cub. ft. per min. of free air, up to a pressure of 170 lbs. per sq. in. gauge when running at a speed of 3,000 revs. per min. This output corresponds to an input of 12,000 to 13,000 horse-power, measured at the shaft.

The outstanding advantages of turbo-compressors as compared with reciprocating compressors may be summarised as follows:—(1) The floor space occupied is much smaller, the capital expenditure is less, and the overall efficiency is higher. (2) Much lighter foundations are required, and the turbine drive permits of the condenser being placed immediately below the turbine with a consequent reduction in the length of the eduction pipe. (3) No internal lubrication of the compressor is necessary, and since with turbine drive forced lubrication is provided to all bearings, a considerable amount of oil is thus saved and less attention is required. (4) The turbo-compressor permits of the use of exhaust steam from winding, hauling, rolling-mill engines, etc. (5) The supply of air from a turbo-compressor is free from oil, which is a *sine qua non* in the case of certain chemical processes. (6) The air delivered by a turbo-compressor is continuous in supply, and not pulsating as in the case of reciprocating machines.

The attainment of high efficiency in a turbo-compressor lies in the correct acceleration with least losses, and the careful conversion of energy of motion into energy of pressure. Another vital point is the provision of adequate cooling during the compression process. The multi-stage construction employed in building turbo-compressors permits of the advantages of cooling, and it is possible to approach the isothermal pressure curve more closely than in a piston compressor with staged compression and intermediate cooling.

In the British Thompson-Houston Company's turbo-compressors, the air, inhaled through a suitable duct, passes through a number of stages in series, the stages being divided over two casings since the number of

impellers is too large to be carried on one shaft. The work done in compressing the air in each set of stages is approximately of equal value. The impellers are constructed of high-tensile strength steel and are forced on to the shafts by hydraulic pressure, the fit between the impeller and shaft being provided by means of special bronze rings embedded in the bore of the impeller. By means of this construction loose fits, with consequent vibration, are an unknown quantity. The vanes are attached to the impeller discs in such a manner that trouble due to loose vanes is an impossibility.

The flow of air through the two sets of impellers is so arranged that the end thrust of one set of impellers is eliminated by that of the other set of impellers, the two shafts butting together between the bearings to be found in the centre pedestal situated between the two casings. The connection between the two shafts for driving purposes is through a flexible coupling of the claw type, and the coupling between the turbine and the compressor is also of the same type.

The two casings are connected together beneath the floor level by means of piping, and if a comparatively low temperature of air at the delivery of the compressor is required, an inter-cooler may be connected in at this point in place of the pipe mentioned above. By this means the temperature of the air at the delivery of the machine can be reduced down to approximately 136 deg. Fah. with an inlet cooling-water temperature of 50 deg. Fah., the final air pressure in this case being 120 lbs. per sq. in. gauge.

After the air has passed through an impeller, it passes through a set of guide vanes in the diffusers by means of which a high efficiency is obtained, and by the suitable design of these vanes a very silent operation of the com pressor.

The air is effectively cooled as it passes through the casing. The water jackets surround the impeller chambers, the diffusers and the return passages, whilst the hollow partitions separating the return passages from the diffusers are also supplied with circulating water. The water is made to follow a very circuitous path through both the water jackets and hollow partitions, and by this means an effective circulation from the point of view of transference of heat is maintained. No internal water-tight connections have to be made between the upper and lower halves of the casing, as all the water connections are external. Cooling blades of cast-iron are attached to the hollow partitions between the stages for the purpose of increasing the cooling surface.

The sealing of the openings in diaphragms, through which the shaft passes from stage to stage, and also in the covers of the casings, is effected by a patented construction consisting of an internally-grooved ring split into four parts and held together by leaf openings. The ring fits in a groove turned in the diaphragm which prevents it moving inwards on to the shaft, but at same time allows it free movement outwards. This effectually guards against any risk of damage due to inaccurate assembly and enables fine shaft clearances to be used without danger.

In order to maintain a constant pressure of air at the delivery of the compressor, independent of the quantity of air being used, the speed of revolution of the turbine and compressor is varied. This effect is produced by means of a piston moving in a cylinder which is under the action of the delivery air pressure from the turbo-compressor. The piston operates the pilot valve which controls the supply of steam to the turbine. In actual operation it is found that this type of governor will maintain the pressure at the delivery of this compressor constant to within 2 to 3 lbs. per sq-in., with a variation in output on the delivery mains from practically full load to no load and *vice versa*.

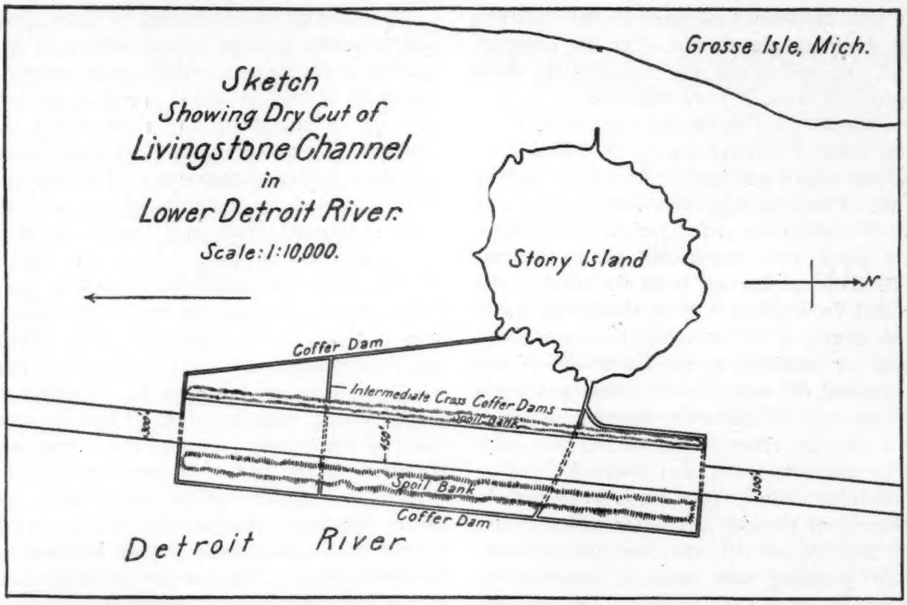
The compressor shown in the photograph reproduced herewith is driven by a mixed-pressure turbine of the Curtis type. The machine is in operation at a well-known colliery in the Midlands (England) and receives its supply of exhaust steam from winding, hauling and other engines at the pit brow. The capacity of the machine is 5,000 cub. ft. of free air per min., up to a pressure of 80 lbs. per. sq. in. gauge. It has also an overload capacity of 6,250 cub. ft. of free air per min. at the same delivery pressure. The normal speed of rotation is 4,600 revs. per min. at full load. The machine is not provided with an inter-cooler, as a low temperature of air at delivery was not specified.

The compressed air is employed in coal-cutting, operating haulages, ventilating, etc. Although the demand for compressed air in the case of this machine varies very considerably and ranges at times from 5,000 down to 1,500

to 2,000 cub. ft. per min. in less than 30 secs., the variation in pressure of the air at the delivery of the compressor does not exceed 2 lbs. per sq. in.

DRY EXCAVATION OF LIVINGSTONE CHANNEL

Among the most important and valuable of the works of the national government for the improvement of our internal waterways was the Livingstone Channel in the lower Detroit River. This deep channel was excavated through solid limestone rock and affords a direct and safe passage for the immense ves-



more vessels and a greater tonnage pass through it than through any other waterway in the world, and the $10,000,000 which the work of improvement cost was money well spent.

The entire scheme was to develop the channel to a depth of 22 feet at a low water stage for 300 feet width and about 6 miles in length at its north end, and for 800 feet width and about 5 miles length at its south end to deep water in Lake Erie. Throughout the greater portion of the length the work was carried on by the usual subaqueous method of rock and earth excavation, the equipment consisting of dredges, drill-boats and other floating plant, sel traffic of the great lakes. It is said that and this work was described in the technical journals at about the time of its completion four years ago.

For a length of about one mile, however, abreast of Stony Island near the north end, the channelway was surrounded by earth dams, the enclosed area being then unwatered and the excavation made by the dry method. Within the area enclosed by the dams there was very little earth covering the rock and the depth of rock cutting varied from 12 to 18 feet. The rock was a Dolomite limestone of Silurian formation, lying in strata of from 1 to 4 feet thick. All the work of constructing the dams, unwatering the enclosed area and making the necessary excavation was done by contractors (Grant Smith & Co. and Locker) in an unusually expeditious manner, a description of the operations by Mr. C. Y. Dixon, Assistant Engineer appearing in a recent issue of *Professional Memoirs.*

The contractors leased Stony Island, which was privately owned, and used it as a base of operations. On the east shore of the island there was installed an air compressor plant which was substantially housed, also there were erected about forty buildings, including repair shops, warehouse, store, rooming house, mess hall, school house and a number of dwellings for employees, the work continuing for about forty months.

EQUIPMENT

The plant and equipment was as follows: Air compressor plant, small locomotive with eight flat cars on about 1½ miles of track, seventeen pumps of various sizes, fourteen portable tripod drills, five traction drills, three channelers, three steam shovels and three cableway conveyors. Also, there were used for building the dams two derrick boats, five flat scows and three launches. The number of employees averaged about 250.

The total length of channel surrounded by dams was about 5,800 feet, and the inclosed area had an average width of about 1,200 feet, being about 160 acres. This area was divided into three parts, each surrounded by dams. Each area was unwatered as soon as the inclosing dams were completed, and after the unwatering of the end areas the intermediate dams crossing the channel were removed.

CENTRIFUGAL PUMPS AND AIR LIFTS

The work of unwatering the central area of 2,800 feet length was begun October 5, 1908, by the use of two 12-inch centrifugal pumps and an air lift consisting of forty-eight 8-inch pipes. These pipes were suspended at an inclination of about 30 degrees from the vertical and extended from about 1 foot above the water surface nearly to the bottom of the river. Compressed air admitted at the lower end of the pipes caused the water to be discharged from the pipes into a sluiceway, through which it flowed into the river. This air lift was very efficient until the water was lowered from 12 feet depth to about 7 feet depth when the air was forced up through the water without raising it, and the air lift was then discontinued. Further pumping was done as required by the progress of the excavation. The leakage through the dams was small, and after the initial unwatering the pumping was mainly that due to rains and melting snow.

CHANNELING

Prior to blasting the rock to be excavated, that along the side lines was cut to the required depth by channelers, which were air driven and three in number. Each channeler was operated by three men working in eight-hour shifts, usually for sixteen hours per day.

DRILLING AND BLASTING

The rock to be excavated between the channeled side lines was broken by drilling and blasting. The number of small portable tripod drills used varied from five to fourteen. Also, there were used at different times five traction drills mounted on trucks. These traction drills were equipped for "pinning up," so as to be rigid when in operation, and with a special device for washing out the sludge, making them much more efficient than the small portable tripod drills. All drills were air driven, and each was operated by two men working in eight-hour shifts, usually for sixteen hours per day. The holes were usually drilled at the corners of 6-foot squares. In blasting the rock two grades of dynamite were used, 60 per cent and 40 per cent., the latter near the side lines reducing the danger of shattering the channel face of the wall.

EXCAVATION

The material was excavated by steam shovels and deposited in skips or iron baskets of about 5 cubic yards capacity, which were carried by cableway conveyors about 400 feet to points back of either side of the channel and there dumped. There were used three steam shovels and three cableway conveyors. The conveyors were operated by compressed air, and they were suspended from two towers about 100 feet high, one on each side of the channel. As the work advanced the cableway towers were moved forward on tracks in order to keep abreast of the steam shovels. Following the steam shovels, a gang of laborers cleared the bottom of all loose rock, which was placed in the skips by hand. Then the elevations of the highest points of the bottom were obtained by the use of a surveyor's level to insure the required grade being made, and where necessary, high points of rock were removed by further drilling and blasting and by hand labor. Thus, as the work advanced it was left completed. The steam shovels and cableway conveyors were operated in eight-hour shifts, usually for twenty-four hours per day. The number of men in each shift with steam shovel and cableway conveyor was 3 on steam shovel, 2 on cableway conveyor, 1 bell-boy to give signals for operating cableway, 1 man to hook skips to cableway, and 1 foreman and 6 laborers excavating by hand labor, being a total of 14 men.

GENERAL USE OF COMPRESSED AIR

Compressed air was the principal motive power for pumps, channelers, drills, cableway conveyors and shops. The compressor plant consisted of two units, one of about 700 horsepower and one of about 300 horsepower. Usu-

ally, during working hours, the compressor plant was operated to full capacity; but at night when only a portion of other plant was at work, and on Sundays when only the pumps were in use, one compressor working at low speed furnished ample power for all purposes. There was therefore frequent opportunity for repairs to compressors and they were kept in excellent condition throughout the entire period of the work. This plant was operated by men working in three 8-hour shifts per day. The force of each shift consisted of 1 engineman, 2 oilers, 1 fireman and 2 laborers. The air was delivered to the main line pipe under a pressure of 90 pounds per square inch, at a temperature of 230 degrees F. The main line pipe was 8 inches in diameter and about 7,500 feet long, and it was placed on top of the dam surrounding the inclosure. At frequent intervals along the main line pipe, distributing pipes from 1 to 6 inches in diameter conveyed the compressed air to points on the work where needed. The pipe lines required the constant attention of about four men in laying and shifting distributing lines, in stopping air leakage and in drawing off moisture. During cold weather fires were necessary at frequent intervals under the pipes to prevent moisture from freezing and stopping the flow of air. Also, for greater efficiency, the compressed air passed through reheaters before use in the operation of channelers and cableway conveyors.

SAVING OF TIME AND COST

The cost of this improvement was about $600,000 less than it would have been by the usual subaqueous method, as indicated by prices named in proposals for the work. In addition to this saving, the work was done in about 75 per cent. of the time that would otherwise have been required, and vessels using this channel are much less liable to injury, because of the smooth vertical sides and nearly even bottom. Livingstone Channel was formally opened to navigation on October 19, 1912. Since that date this route has been used by all downbound freight steamers—all upbound vessels being required to use the channel formerly improved near the Canadian shore at the mouth of Detroit River.

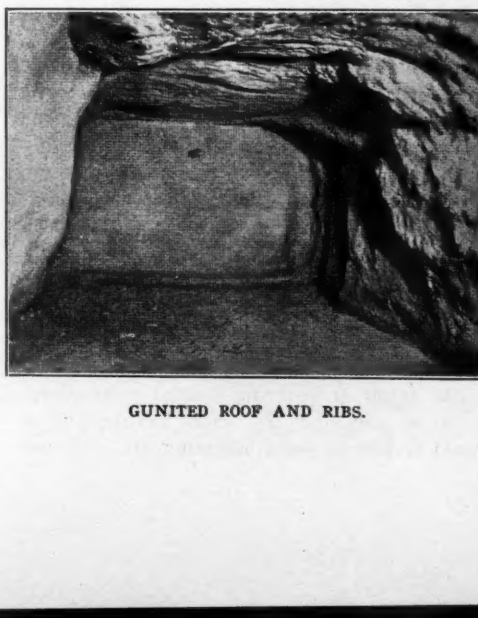
It is safer to solder your gasoline tank when full than when empty.

CEMENT GUN IN POSITION.

THE CEMENT GUN TO PREVENT ROOF SLACKING IN COAL MINES

The extremely hot weather during the past summer has been the cause of considerable roof slacking in the various bituminous fields, to a greater degree than has been the case for several previous years. This has been so marked in numerous instances as to cause the focusing of attention on some method of protecting these surfaces against the attacks of air and moisture. It seems pertinent, therefore, in this connection to call attention to the satisfactory results that have been obtained in two instances through the use of the cement gun.

Early in 1914, L. M. Jones, mining engineer in charge of the Coal Mining Department of the Bureau of Mines, used a cement gun to line the two slope entries at the Experiment mine, near Bruceton, Penn. His reason for



GUNITED ROOF AND RIBS.

making this lining was that when it was determined to use this mine for the purpose of making explosion tests with anthracite dust, the anthracite operators objected because they felt that there would be present a large amount of bituminous dust which would affect the conditions.

The inner end of the main slope and the air entry, for about 360 ft. of each, were therefore coated with "gunite" and brushed fairly smooth to insure against the possibility of bituminous dust finding a lodgment there. This left the two entries, each of which is about 1,300 ft. long, with an entrance lining of concrete for 300 ft., an untreated length of 650 ft. and a gunited portion as noted above. This work was completed early in the fall. The explosion tests were started about Oct. 15 and have continued at the rate of about three explosions per week ever since, except during the summer months, or between about May 15 and Oct. 15.

At the time that the guniting was done, there was marked indication of slacking taking place along the sides of the entry, and along the uncovered portion these now exist to a considerable degree. In the covered portion, however, there is no indication of slacking having advanced at all, as the sides are entirely unbroken and there has been no scaling. There are, as would be expected, a number of places where slabs of the mortar have broken, away from the roof, owing to the heavy explosions. These have been patched by hand, as the bureau has not had a cement gun available for such work.

When the bureau finished with the cement gun at Experiment, it was sent to the H. C. Frick Coke Co. at Mount Pleasant, Penn., and was used by the superintendent, James Mack, for a similar purpose. Considerable trouble had been experienced at this time with the roof and sides of the entry approaches to the shaft level slacking, and a coating varying from 1-16 in. to 4 in. or more was shot on. This protection has been so successful that no further work of any character has been necessary in two years along the coated portions.

In coating the surfaces of the entries at Experiment, Mr. Jones kept accurate costs of the work as in column following.

The depth of covering ranged from about ¼ in. to 4 in., but Mr. Jones advises that it would be best to use a minimum of ½ in. and

Air Course

Size of entry.........	5.9 (height) by 9.15 ft.
Lineal feet coated..................	358
Square feet coated..................	8,100
Cost of labor (including supervision)	$172.64
Material	114.38
Total	$287.02
Cost per square foot, labor............	$0.0213
Cost per square foot, material.........	.0141
Labor and material, per square foot	$0.0354
Cost per foot advance.................	$0.76
Cost per square yard..................	.319
Speed..................................	11¼ sq.yd. per hr.

Entry

Square feet coated..................	8,925
Lineal feet coated..................	425
Cost of labor	$232.38
Materials	161.81
Total	$394.19
Cost per square foot..................	$0.0441
Cost per foot advance.................	.928
Cost per square yard	.397

states that it is not necessary to build out the low places to a continuous surface, as was done by the bureau because of explosion conditions.

Inasmuch as this work, if as successful as the above experiences would indicate, would save an annual expenditure in some cases running into thousands of dollars, besides meaning the saving of an original cost of timberwork and the guarding against many operating delays, it would seem that these experiments warrant the careful consideration of every mine superintendent and engineer in the country.—*Coal Age.*

DUST, SAND, WIND

BY DR. H. LIPSCHÜTZ

When a rock has crumbled into sand and dust the fine particles become the sport of the winds unless they are solidified by natural or artificial means. The sand is carried along by the wind over the ground in heavy clouds. The fine dust, on the other hand, is whirled high in the air, coming to rest weeks later. The finer the grain of sand or dust the farther it is carried by the wind. Dust 1-64 millimeter (.00061 in.) in diameter may be blown around the entire earth. The largest sand-grains the wind is capable of carrying have a diameter of 2 millimeters (.078 in.) With a fineness of 0.125 to 0.25 millimeters (.005 to .01 in.) the wind can carry it more than a kilometer (⅝ mile). The North German flying sands range in diameter from 0.2 to 0.5 millimeters (.0078 in. to .0196 in.)

Flying sand may be formed in different ways.

It can come from every rock containing quartz and from every sedimentary stone containing sand. Thus we find in Egypt and Tripoli many deserts where the flying sand arises from the weathering of sandstone. . . . The waves of the sea constantly bear to the shore new material composed of fine quartz sand. After being dried . . . it is driven landwards by the wind and heaped into long hills near the shore, known as dunes. If the dunes do not become solidified the wind constantly drives them farther inland, with the result that everything they pass becomes covered with sand.

Just as by the sea, so can flying sand be found on the shores of great inland lakes. Thus, for example, we find dunes on the shores of the Aral and Caspian Seas. Loose masses of sand piled up into hills by the wind in the interior are known as land dunes. They are frequently formed by the sand of rivers. Thus the river dunes on the left shore of the Volga, near Kasan, penetrating far into the Kirghis Steppe, are formed of river mud which has lost its particles of clay. We observe this on a greater scale near the Central Asiatic rivers, Amudarja and Syrdarja. These rivers carry enormous masses of sandy mud, almost filling their beds. Borings in the bed of the former have shown as great a depth of mud as 23 meters (75 ft.) Under such conditions the banks are naturally flooded as soon as the water rises, and the sandy mud is spread over a wide flooded area. After the water falls the hot wind quickly dries out the mud and blows away the dust and lighter particles of mud, that is, the clayey substances. The pure sand remaining is piled into dunes by the wind and driven on. In this way the deserts Kysilkum and Karakum have been formed. Seven per cent. of our total land area has been taken possession of by loose sand. In this manner desolate deserts have been made of localities once fertile and blooming, e. g., in Mesopotamia, and stretches of the Nile Valley. Land may be preserved by protective measures, such as damming, irrigating and planting. The planting is usually of trees.

A thoughtless removal of protective plant covering may even to-day cause the formation of sand deserts in the interior.

Let us now follow briefly the destiny of the fine dust. According to Richthofen every desert is a storm center. Since damp earth cannot be carried by wind, consequently all dust must wander on the wings of the wind

CUT IN SCHAN SI, CHINA.

until it has left the desert behind, i. e., till it has found moist earth protected from the action of the wind, or has been washed down by rains. We can scarcely form a conception of the monstrous masses of dust drifting in air currents. On the Red Sea the dust-filled winds coming from the African deserts form the well-known dust-fogs, which are so dense as to be dangerous to vessels. The regions bordering deserts, in which the dust is largely deposited, are called steppes. Here the winds are less strong than in the desert; moreover, the ground is fructified by more frequent precipitation. These conditions tend not only to cause a depositing of the dust, but its retention on the ground. According to Richthofen permanent settling and holding down of the dust is in general made possible only by a covering of vegetation. The deposits made in this way cover immense regions. They are known under the name of loess.

They are of greatest extent in China. They also attain usually a great depth, in China as

much as 700 meters (2,300 ft.) (The illustration shows a road through the loess formation in the province of Schan Si.) In Germany such deposits are found in the Rhine and Main valleys, and on the northern edge of the Central Mountain chain of Saxony. In the Rhine valley the depth is 30 meters. Such regions are generally dry where they form steppes. The precipitation suffices to cause a luxurious growth of grass, but not of forest. Hence, the steppes are mostly treeless. The famous Russian black earth is nothing but such deposits, whose humus content comes from the decaying vegetation of the steppes. Black earth is formed where the precipitation is greater than on the real steppe. However, it is treeless. Extensive regions of black earth are found in the United States and in the Argentine. They are very fertile because composed of fine particles of clay, and this clay holds the nutritious substances, whereas soil composed of loose sand is almost sterile.

SULPHUR MINES HAVE THE LARGEST OIL-BURNING POWER PLANT

The plant of the Freeport Sulphur Co. at Freeport, Tex., at the mouth of the Brazos river, is being greatly enlarged, the engineers for the work being Westinghouse, Church, Kerr & Co. of New York. The sulphur deposits underlie Bryan heights, one of the domes which dot the coastal plain. It has an area of about 500 acres, and its crest is but 28 feet above mean low tide. The sulphur-bearing horizon lies many hundred feet under the surface, surmounted by a limestone cap, the sulphur occurring in pockets and veins in a porous gypsum formation heavily loaded with water, as it is below sea level. To recover the sulphur millions of gallons of boiling water are forced into the formation under heavy pressure, searching out the sulphur and freeing it from the rock which contains it. Sulphur melts at 238 degrees F. In its melted state it is pumped by compressed air to the surface, where it is forced through piping to immense storage bins, where it congeals and builds up huge blocks of solid sulphur 99½ per cent. pure.

The largest oil-burning steam boiler plant in this country has been established at the mines to recover the sulphur. The experimental plant, known as plant No. 1, was built in 1912 and has a capacity of 3,000 boiler horse-power. Plant No. 2 was built adjoining plant No. 1 in 1914, and has a capacity of 4,000 boiler horse-power. Plant No. 3, finished this year, and plant No. 4, now under construction, are situated on the other side of the mound, and have a capacity of 8,400 horse-power each, making a total installation of 23,800 horse-power. The buildings are constructed of steel and corrugated iron on concrete foundations. Fuel oil for boiler purposes requires continual tank steamer service from the Mexican oil fields, and the Freeport Sulphur Co. owns and operates its own tank line.

The boiler water supply is obtained from a series of wells, pumped by air compressors, and is stored in two reservoirs. The mine water supply is obtained from the river through a canal 3½ miles long, and is pumped into two separate reservoirs. Both mine and boiler water are treated with calcium hydrate to remove scale-producing salts before going to the reservoirs, where the precipitation takes place. The precipitated sludge is periodically pumped from the reservoirs by a hydraulic suction dredge. A day's water supply is pumped and treated in eight hours, and 7,000 pounds of calicum hydrate are daily used in the process. As far as is known, there is no other plant in this country treating water for the removal of scale-producing salts in any such quantity.

All excess steam about the plant is used for heating water. After scale-producing salts have been removed from the boiler water there still remain salts which cannot be removed by chemical treatment and cause foaming and priming in the boilers. The concentration in the boilers is kept within safe limits by continuously blowing them off and special arrangements are made for recovering the heat from the blow-off water.

The above we have abstracted from a more detailed and complete description in Manufacturers Record, Nov. 9.

A CHANCE FOR SOMEBODY

the Compressed Air Magazine Co.
Dear Sir

I have invented a Air Motor it have Power enough to Pump water and not cost the oner a cent in Power and will do other work as well henny one can start this Motor by a turn of crank I do want some one to help me to build a large Air Motor and get it Patent in all Countrys I will allso give half to the one that will help me if you can get some one I will be please Yours truly

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

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CONTENTS

THE METRIC SYSTEM FREE TO ALL

The Philadelphia Bourse is conducting an inquiry among manufacturers and exporters as to their views on the proposed general adoption of the metric system in the United States. It has elicited, among a variety of other contributions, the following statement by Coleman Sellers, Jr., president and engineer of William Sellers & Co., Inc., machine-tool manufacturers:

"I would certainly recommend exporters to make any use of the metric system that will facilitate their foreign business, such as expressing weights and dimensions in the units used by the purchaser, if he so desires. The Bourse is to be commended for putting the necessary information before manufacturers and exporters, but I should be very sorry to see it lend itself to any propaganda designed to force the use of the metric system on the whole country by act of Congress.

"The French units have been legalized by our Government and accurate standards have been prepared for distribution. This, I think, is as far as the Government should go. I am perfectly willing that any one shall make what use of the metric system he deems desirable, but I object seriously to any attempt to force the extension of the system by legal enactment. The advocates of this course are no doubt absolutely sincere in their belief, but they approach the subject too much from a scientific point of view and do not give due consideration to the practical side. If the system is really better than ours. it will in time supplant without the violent disturbance which would follow an enforced use.

"Our own foreign business is chiefly confined to machine tools or other machinery for working metals, and the metric system is only involved to the extent that we occasionally are required to furnish the principal screws with metric threads, or to arrange a machine to cut metric threads; that is, threads in which the lead or pitch is expressed in millimeters instead of in inches or fractions of an inch. Even this requirement is not universal. We are now building machines for Russia (a metric country) which are required to cut inch threads. It really makes no difference to the buyer of a machine whether the inch or the millimeter has been the unit of measurement used in constructing it.

"As to the use of the system in our own

establishment, I may say that when we began the manufacturing of the Gifford injector about 1860 we followed the drawings of the French inventor, using his units, and all our gages and tools were made accordingly, with the single exception that the threads for the pipe connections conform to the American standard. We have continued to use the metric units in this department since it started, with entire satisfaction, but with no desire to extend it to the rest of our establishment.

"To change a manufacturing plant such as ours from one system to the other is not so simple a matter as merely substituting a rule differently graduated, but it involves a large investment in tools and fixtures and an interference with established standards which it is practically impossible to change. This difficulty is very real, as is illustrated by the fact that even in France the metric system is not used to the entire exclusion of other standards; and in other countries, Russia for example, the English system of threads still generally prevails. The matter of thread standards is in a chaotic state in the meter-using countries, and they have not yet agreed to conform with a universal standard of diameters, pitches and forms of thread, although numerous efforts have been made to bring this about. In fact, the subject is in the same confusion that existed in England before Sir Joseph Whitworth introduced his system of screw threads which was suggested by the late William Sellers and officially approved by the Franklin Institute."

TUNNELING MACHINE DEMONSTRATION

What is claimed to have been a successful demonstration of a rock tunneling machine driven by compressed air has recently been given in the subway excavation at Grand Central Terminal, New York. According to the published statement, a tunnel 8 ft. in diameter was driven 2½ ft. through solid rock in 8 hours of elapsed time, including delays for removing muck and other purposes. For 3 hours and 57 minutes of actual running time the progress averaged 7.6 inches per hour.

This machine, which has been developed by Oliver O. App, for the Rock Tunneling Machine Co., New York, consists essentially of 14 pneumatic hammers with chisel points, fixed in a cross head mounted in a 12-inch horizontal shaft driven by a compressed air engine. Extreme variation in the hardness of the rock and the irregular resistances due to sand pockets, open seams, etc., are provided for by pneumatic control that proportions the amount of air in the hammer exactly to the resistance encountered and stops the hammer action when the resistance is very light. The machine removes the broken rock from the heading and delivers it to a conveyor that discharges into muck cars at the rear.

It may be noted that the entire class of machines of which this may be the best up-to-date representative, works on the principle of dispensing entirely with the use of explosives and breaks up the entire face of the rock by mechanical means as it advances. To assume that this can be successfully and profitably accomplished would seem to be at varience with all experience in rock excavation.

NEW BOOK

Handbook of Rock Excavation, Methods and Costs. By Halbert P. Gillette. 842 pages 5 by 7 ins., 184 illustrations, 87 tables, flexible leather. New York, Clark Book Co., $5.00.

The author of this work is a leading authority upon the subject of which he treats, and he has had exceptional opportunities for collecting precise data at first hand. The book contains all the information of present and future value originally published 12 years ago in "Rock Excavation, Methods and Costs," with about twice as much more additional material since collected and all having the same characteristics of accurate reliability and up-to-dateness . The copious cost data are perhaps the most valuable single feature of the work, and accompanying these are descriptions of a large number of methods of excavating and transporting rocks under difficult conditions which give the reader the necessary particulars to enable him to analyse and interpret the figures.

The completeness with which the entire field is covered is sufficiently suggested by the titles of the successive chapters, which are as follows: Rocks and their Properties; Methods and Costs of Hand Drilling; Drill Bits; Shape, Sharpening and Tempering; Machine Drills and their Use; Core Drills; Explosives; Charging and Firing; Methods of Blasting; Loading and Transporting Rock; Quarrying Dimension Stone; Open Cut Excavation in Rubble Quarries, Pits and Mines; Railroad

Rock Excavation and Boulder Blasting; Canal Excavation; Trench Work; Subaqueous Rock Excavation.

NEW PUBLICATIONS OF THE BUREAU OF MINES

BULLETINS

Bulletin 108. Melting aluminum chips, by H. W. Gillett and G. M. James. 1916. 88 pp.

Bulletin 126. Abstracts of current decisions on mines and mining, reported from January to April, 1916, by J. W. Thompson. 1916. 90 pp.

Bulletin 134. The use of mud-laden fluid in oil and gas wells, by J. O. Lewis and W. F. McMurray. 1916. 86 pp., 3 pls., 18 figs.

TECHNICAL PAPERS

Technical Paper 130. Underground wastes in oil and gas fields and methods of prevention, by W. F. McMurray and J. O. Lewis. 1916. 28 pp., 1 pl., 8 figs.

Technical Paper 136. Safe practice at blast furnaces; a manual for foremen and men, by F. H. Willcox. 1916. 73 pp., 1 pl., 43 figs.

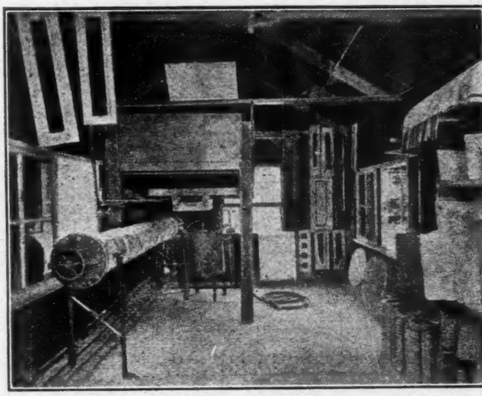
Technical Paper 146. The nitration of toluene, by E. J. Hoffman. 1916. 32 pp.

Technical Paper 157. A method of measuring the viscosity of blast-furnace slag at high temperatures, by A. L. Field. 1916. 29 pp., 7 figs.

NOTE.—Only a limited supply of these publications is available for free distribution, and applicants are asked to co-operate in insuring an equitable distribution by selecting publications that are of especial interest. Requests for all papers can not be granted. Publications should be ordered by number and title. Applications should be addressed to the Director of the Bureau of Mines, Washington, D. C.

Air-pressure tanks carrying over 25 lb. per sq. in. are to be inspected biennially by the California Industrial Accident Commission. There was one fatal accident in 1915, 6 permanent and 343 temporary injuries.

There are 1,525 miles of cast-iron pipe in service in Baltimore, some of which has done duty for 111 years, states the Cast Iron Pipe Publicity Bureau, New York City. "Exceptional endurance, little or no depreciation—that's cast-iron pipe."



GLASS SAND BLASTING ROOM.

SAND BLASTING MAKES SCRAP GLASS USABLE

The portable sand blasting plant installed by the Northern Ohio Traction & Light Company, Akron, Ohio, in addition to performing its usual functions, has been found to be useful for making clear scrap glass usable. Both clear and Florentine glass are used in this company's cars, the latter serving exclusively in the deck sashes and door panels. Since both of these are of small dimensions, it frequently occurs that there is clear scrap glass which could be used at these points if it were chipped. The chipping is accomplished by applying one coat of cheap glue to the sand-blasted clear glass. The glue in drying curls and chips the surface of the glass, and to hasten this drying process electric heaters are frequently used. The margins of this chipped glass are left sanded and, in some instances, as in the case of the door panels, the lettering is sand blasted on the glass. This sand-blast equipment is also used for lettering clear glass, for such signs as "Have Your Fare Ready," "No Smoking," "Passengers Must Not Talk to Motormen," or any others which may be readily displayed on the sashes and glass door panels.

At first a home-made sand-blasting outfit was provided, but so many useful things could be accomplished by sand blasting that a special outfit was purchased from the American Foundry & Equipment Company. As a general proposition the sand-blasting is done in a building especially provided for that purpose, which is shown in the accompanying illustration. All work that can be brought to the sand-blasting plant is handled in this building,

but when it is necessary to sand-blast cars in the paint shop the outfit is moved to that point. The operation of the sand-blasting equipment is in charge of the upholsterer, as it is only required two or three days a month. Whenever the stock of sand-blasted or Florentine glass becomes low, he replenishes it, and as occasion demands, performs other sand-blasting operations.—*Electric Railway Journal.*

GOOD LONG DISTANCE ADVERTISING

Here in the United States, says a writer in the current number of *The Nation's Business,* are fully 2,000 students from the republics of Latin America; 1,500 from China; 1,000 from Japan; 500 from the Philippines, and hundreds from Russia, the near East and India. There are 275 at the University of Pennsylvania; 300 at Cornell; 400 at Columbia; 250 at Michigan; 300 at Illinois; 150 at Wisconsin, and 300 at California. At least 400 are enrolled in the various institutions in Chicago. They represent wealth and influential families and industries. After three to six years of study they will return to positions of power in their home countries. A majority of the foreign students are studying engineering, industrial chemistry, banking, commerce, and business administration; they are introduced to the latest inventions and the most modern appliances used by the mechanical and electrical engineer, the chemist and banker. After four to six years of experience with articles used in American business, it stands to reason that the foreign student will insist on the introduction and use of articles which he has tested and proved satisfactory. No such opporpunity for the expansion of foreign trade has heretofore been presented to the North American business man. It is good business, good ethics, and good diplomacy to win their friendship.

TURKISH IRRIGATION PROJECT

From an engineering viewpoint the Old World, especially the oldest portions of it, is still far from finished. A project for the irrigation of the Adana Plain (the ancient Cilicia), to cost over $17,000,000 and to require from eight to ten years for completion, has been undertaken by the Turkish Government. It is proposed to regulate the course of the three rivers which water the plain—the Saihun, Shihan, and Berdan Shah—and thus open up to agriculture a tract of nearly half a million acres, much of which is at present arid. It is estimated that the completion of this irrigation project and the introduction of fertilizers and up-to-date agricultural machinery will greatly increase Turkey's production of cotton, sugarcane, lemons, oranges, and olives. A part of the irrigation works will be put into operation during the next eighteen months. After the irrigation project becomes a reality the Adana Plain will be the garden spot of the Ottoman dominions. It already possesses excellent transportation facilities, being traversed by the Bagdad Railway and having connection by rail from Adana to Mersina. Furthermore, the important Port of Alexandretta is only thirty miles from the mouth of the Shihan River, which, as well as the two other watering the plain, will be made navigable and will offer a cheap means of transporting the products of the plain to the sea. The regulation of the three rivers will also provide abundant water power for industrial purposes.

AN AIR HAMMER HELPS OUT

After turning out several hundred thousand of a certain part on an outside order, a manufacturer of forgings found that the drawing given him was wrong, and that a certain boss, instead of being 2¼ inches wide, as it had been made, should be only 1⅞ inches, to allow it clearance between two fixed points in the machine in which it was to be used. The discovery was made when the first carload shipment came back from the buyer, and work was practically completed on the contract then. The work of reducing the bosses was started under one of the hammers, but took up so much time, and required so much work that the shop schedule was being disarranged. An air hammer was therefore mounted on a heavy post, and a heavy anvil set up so that it would allow the proper clearance over the work. Then, with a separate furnace to heat the reworking pieces, the air hammer, with a foot control on the valve, was found to work the stock down without any where near the power consumption of the big hammer being used on the job, and the light machine served to dress the four sides of the boss well enough for the first lot sent back to the buyer to appear as new work—and to bring a vigorous protest from him that he would not pay for the remaking of his order. When he found all he

delegated to turn the crank. The blower forces a considerable quantity of air into the bottom of the manhole, which displaces the gas and supplies fresh air to the workmen. In particularly bad instances a continuous operation of the blower has enabled work without danger of asphyxiation.

WIND VELOCITIES AND WAVE HEIGHTS

Some observations were made during the year 1915 on the Belle Fourche Reservoir of the U. S. Reclamation Service to determine the height of waves under various wind velocities. A wave gage was erected well out in the water and a recording anemometer was installed. The height of waves from crest to trough was observed during various periods of high wind velocity, the results being as follows:

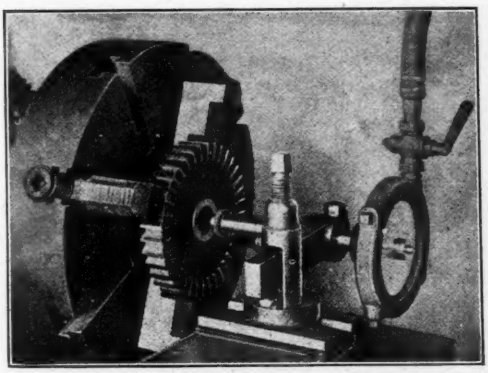
Date.	Wind velocity, miles per hour.	Wave height, feet.
Aug. 28	35	2.0
Sept. 8	40	2.5
July 4	44	2.5
May 16	48	3.5
Oct. 7	50	3.5
June 12	56	4.0
Oct. 24	75	5.0

The fetch of the wind was approximately 5 miles for all observations, and the depth of water during the entire period varied but 3 ft., the mean depth at the gage being approximately 10 ft.

THE COMBINATION SHOT

In some of the coal mines of this country, especially those in the anthracite field, the practice of making what is known as "the combination shot" is common. It is so called because a charge of dynamite and a charge of blasting powder are used in the same bore hole. The blasting powder is ignited either by fuse or miner's squib, the explosion and heat of the blasting powder being depended upon to detonate the dynamite. The miner believes that by loading holes in this manner he is assured that the hole will break clear to the point, on account of the extra strength and extreme quickness of the dynamite. Laws have been passed and are still in the mining laws prohibit-

was being taxed for was the reconstruction—and that it ran less than half of what first estimates had led him to expect, he was mollified.



PNEUMATIC LATHE GRINDER

The half-tone shows a grinder of novel type mounted on a lathe carriage with the emery wheel on the end of the spindle in position for grinding out the hole in the milling cutter mounted in the chuck. As the work is rotated in the lathe the grinding wheel is fed into the hole and back again by the regular carriage feed. This grinder can be used also for external grinding on work projecting from the face-plate. It is also used for truing the lathe centers and other purposes.

An interesting feature of this device is the motor, which is similar in principle to a Pelton water wheel, a jet of air impinging upon a series of blades on the periphery of a disk and producing, in this case, a speed of about 2,000 revs. per min. The grinder is made by Wm. B. Mershon & Co., Saginaw, Mich.

EXPELLING GAS AT STREET MANHOLES

In underground cable work manholes are encountered in which the gas is so bad that it is practically impossible for men to work in them. If the work to be done is of an urgent nature and time cannot be taken to wait for the gas company to repair the leak causing the trouble, special means of ventilating the manhole is essential. The Commonwealth Edison Company of Chicago has made successful use of standard Lancaster geared-type blowers for this purpose. A 10-ft. length of 3-in. hose is connected to the blower and inserted in the manhole and one of the helpers

ing the making of combination shots, but the reprehensible practice is still employed by the miners to a considerable extent, with or without the assent of the operators. According to the best authorities and theory, the combination shot is both dangerous and inefficient.

NOTES

Producing nowadays at a rate of 1,000,000 lbs. of copper a day, Anaconda Copper Co. enjoys the distinction of being the world's largest copper producer. With costs of producing around 11 cts. the company is earning, basing production on 300,000,000 lbs. annually and a 25 ct. market, no less than $18 per share annually.

It is reported that flying from the trenches in France to London and back again in the same day is becoming a not uncommon experience for officers of the British Army. The story is told of how a soldier recently left the trenches in France early in the morning, took a Turkish bath in London some three and a half hours later, lunched at one of the leading hotels in the British metropolis, and returned back to the trenches in the early evening.

A new equipment for killing condemned horses with illuminating gas has been installed in the Denver City Pound. A small air-tight stall is connected with the city gas-main. While the horse is munching his oats or hay from a manger in one side of the stall, the gas enters from a pipe directly underneath. The animal gently and peacefully subsides into insensibility.

From 50 to 75 gals. of distillate, a by-product of tar, from which aniline dyes and products used in manufacturing explosives are obtained, are being produced daily at the Ogden Pintsch gas plant at Ogden, Utah.

In an effort to reach entombed men in the mine of the Jamison Coal and Coke Company, at Barrackville, W. Va., Lewis M. Jones, one of the Bureau of Mines mining engineers, was overcome and died before he could be removed from the mine.

The biggest natural bridges in the world are to be found in the United States. The largest of these, the Rainbow, 308 feet high, would span the dome of the United States Capitol, with room to spare, and is nearly as high as the Flatiron building in New Work. Its span is six times as great as that of the Natural bridge of Virginia. Utah alone has three natural bridges that are higher and of greater span than any other natural bridge in the world.

A mine explosion at Marvel, Ala., on Oct. 22 caused the death of every man in the mine of the Roden Coal Co., except one—17 men. The one who escaped was a pumpman in one of the upper headings. All the men killed had gone into the mine to install a new electric-feeder cable. Open lights were used, but up to this time the mine had not been considered gassy. The United States Bureau of Mines mine-rescue car was sent to the scene of the explosion, but by the time it arrived gas helmets were no longer necessary.

The following are the leading particulars of the super-Zeppelin L-33 which was brought to earth in England on September 23: Length, 680 ft., total weight with crew and officers 50 tons; six 240 horse-power engines with a speed of 1,600 revolutions per minute, three engines being placed in one gondola and one in each of the others; estimated quantity of petrol carried 2,000 gallons, and gas capacity of the envelope 2,000,000 cubic feet. The vessel carried seven or eight guns, including five Maxims and sixty bomb droppers.

The largest dam in Europe has recently been completed by American engineers, near the old fortified town of Talarn, in Spain. The Noguera Pallaresa River flows through the chasm where the dam is built with cliffs nearly vertical on either side. The dam is 330 ft. high, 700 ft. long, 230 ft. through at the base, decreasing to 14 ft. at the top. The lake formed by the impounded water will be 15½ miles long and 3¾ miles wide. The water will be carried by a system of canals into an arid district to irrigate a surface of nearly a hundred square miles. A large horse-power also will be developed.

The proportion of machine-mined bituminous coal to the total putput has increased each year. In 1915 the proportion was 55 per cent.,

twice that of 1903, twelve years before, and the number of tons so mined in 1915 was more than three times that in 1903. It is interesting to note that among the nine States ranking highest in order of bituminous production—that is, producing 8,000,000 tons or more—all but two, Alabama and Colorado, showed more than half mined by machines; and that among all the other States only two, Montana and Michigan, recorded like proportions.

The calorific value of illuminating gas, so-called, and not its candlepower has been established as the standard by the Public Service Commission for the Second District, State of New York. All companies making more than 20,000,000 cu. ft. per year of coal, water or mixed gas must show a product averaging 585 B.t.u. per cu. ft. The change has been made to accord with the development of the gas industry, which is toward consumption in bunsen-burner apparatus, where the usefulness depends on heat content and not on candlepower of an open flame. The cost of oils introduced into ordinary gas to raise the candlepower has greatly increased as the utility of the enrichment has diminished.

In the Bureau of Yards and Docks of the United States Navy the problem of designing flag poles led to a study of the pull of flags of different dimensions and under different wind velocities. Two sizes of flags were used, one a No. 7, 3x5½ ft., the other a No. 8, 2½x 4¼ ft. The flags were tried in wind velocities of from 20 to 60 mi. per hr. and the results show that the total horizontal resistance of a flag, exposed to a steady current of air, can be approximately represented by the formula $R = CAV^{1.9}$, where R = the resistance in pounds, A = area in sq. ft., V = velocity of wind in mi. per hr., C = 0.00030. The value of C decreases slightly with the size of the flag; that is, the resistance per square foot of area decreases slightly with the increase of size.

The New York up-state commission has decided that the use of compressors on natural gas lines cannot be restrained by the commission. If the use of compressors injures landowners who lease gas wells to a company using the compressor, the remedy lies with the courts and not with the commission. Commissioner Hodson reviews the contention of the complainants that compressors make the gas flow faster from wells than it would under natural conditions, but points out that the experts of the companies gave the more convincing proof that compressors do not increase the amount of gas drawn from wells, but merely boost the pressure to a degree necessary for its transmission. The ground for denial of the complaint however, is that the commission is without jurisdiction.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

OCTOBER 3.

1,199,772. VACUUM-BOTTLE. JOHN J. ENGEL, Pittsburgh, Pa.

1,199,792. ELECTRO - PNEUMATIC ORGAN-VALVE. ROBERT HOPE-JONES, deceased, North Tonawanda, N. Y.

1,199,804. AIR-MOTOR. CHARLES MCGREGOR, Derry, N. H.

1,199,807. MOTOR APPARATUS. CALVIN A. MILLER, Ellsworth, Pa.

1,199,838-39-40. FLUID - PRESSURE BRAKE APPARATUS. WALTER V. TURNER, Edgewood, Pa.

1,199,847. AUTOMATIC PRESSURE - REGULATOR. THOMAS M. WILKINS, East Randolph, N. Y.

1,199,900. PRESSURE - REGULATING DEVICE. AUGUST KADOW, Toledo, Ohio.

1,199,904. FLUID SPEED-CHANGING GEAR. MILTON A. KETTLER, Washington, D. C.

1,199,910. AIR CUSHION OR SPRING. PETER A. MCCULLOUGH, Pittsburgh, Pa.

1,200,170. FLUID - COMPRESSOR. WILLIAM F. COLLINS, Pasadena, Cal.

1,200,371. VACUUM - PRODUCER. WACLAW KOSSAKOWSKI, Chicago, Ill.

1,200,402. APPARATUS FOR LIFTING LIQUIDS. JAMES M. WASSON and MICHAEL E. CAHN, New Orleans, La.

1. Apparatus for lifting liquids, comprising a cylindrical casing, an air pipe projecting down into said cylindrical casing and provided with a series of tangentially disposed curved expanding nozzles projecting therefrom, and means for supplying compressed air to said air pipe, substantially as described.

1,200,446. AIR-SPRING. JOHN G. FUNK, Swissvale, Pa.

OCTOBER 10.

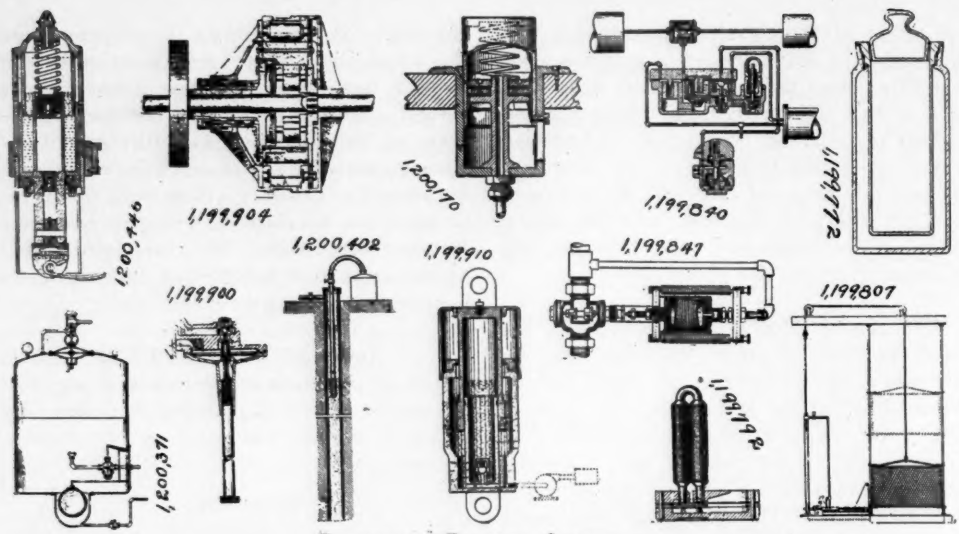
1,200,469. SAND-BLAST MACHINE. JOHN L. DAWES, Pittsburgh, Pa.

1,200,541. COMPRESSED-FLUID STARTING APPARATUS FOR INTERNAL-COMBUSTION ENGINES. FRANK E. TEN EYCK, Auburn, N. Y.

1,200,572. VALVE FOR GAS AND LIQUID MEASURING DEVICES. EDWARD AUGUST APPELL, New York, N. Y.

1,200,699. CONVEYER. GEORGE BERNERT and JACOB BERNERT, Milwaukee, Wis.

The combination of a blower fan and a hopper disposed below the top of the fan, a blower trunk associated with the fan and extending upwardly directly therefrom, a conveyer casing extending upwardly from the hopper and communicating with the blower trunk above and adjacent the fan and a conveyer in the casing.



PNEUMATIC PATENTS OCTOBER 3.

1,200,720. APPARATUS FOR CONTROLLING THE FLOW OF FLUID. JOSEPH BARBE FOURNIER, St. Mande, France.

1,200,859. FLUID-PRESSURE REGULATOR. LEON P. LOWE, San Francisco, Cal.

1,200,869. AERATION AND SUBIRRIGATION FOR PROMOTING VEGETATION. ARCHIBALD HENRY RIFE, San Antonio, Tex.

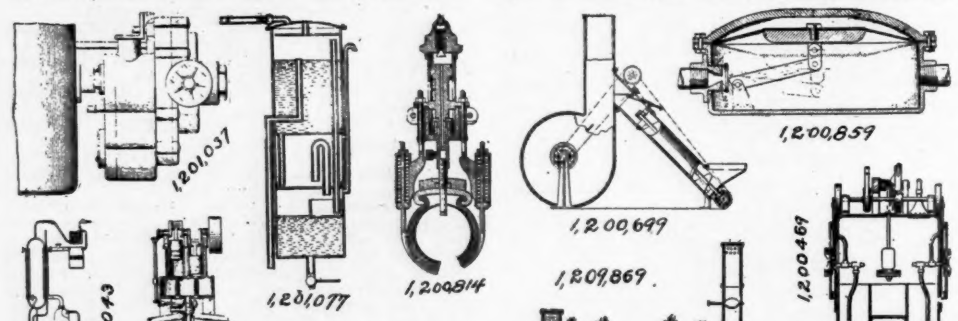
1,200,874. DEVICE FOR AUTOMATICALLY INFLATING AUTOMOBILE-TIRES. GEORGE E. R. ROTHENBUCHER, New York, N. Y.

1,201,037. COMBINED AIR STARTER AND COMPRESSOR. EDWARD E. GRAY, Plano, Ill.

1,201,043-4. APPARATUS FOR DIVIDING AIR INTO ITS ELEMENTS BY FRACTIONAL DISTILLATION. MAURICE HAZARD-FLAMAND, St. Vrain, France.

1,201,073. PUMP. WILLIAM L. MORROW, Los Angeles, Cal.

1. In a pump, the combination of means providing a source of compressed air, a receptacle for liquid to be pumped, an inlet valve for liquid in said receptacle, an unobstructed discharge conduit of less volume than said receptacle having a free connection therewith forming a play pipe, an air conduit connected to said receptacle



PNEUMATIC PATENTS OCTOBER 10.

and means, an air valve disposed in said conduit having a port leading to said means, a port leading to a source of low pressure, and a timing mechanism for continuously operating said air valve to alternately connect said receptacle to said source of compressed air and said source of low pressure.

1,201,077. FUEL-FEEDING DEVICE FOR AUTOMOBILES. WILLIAM H. MUZZY, Dayton, Ohio.

1,201,092. ARTIFICIAL-BREATHING APPARATUS. THOMAS H. PHILLIPS, Baltimore, Md.

1,201,126 SAND-TRAP. WILLIAM H. WHITE, Roanoke, Va.

1,201,149. FORCED-DRAFT BLOWER. WILBER G. COLLINGE, Portland, Oreg.

1,201,155. METHOD OF AND APPARATUS FOR CONVEYING AND MIXING CONCRETE. ALFRED H. DAEHLER, Los Angeles, Cal.

1,201,650. AIR-COOLING DEVICE. MERTIE THIERS, Wichita, Kans.

1,201,660. WATER - DISTRIBUTING APPARATUS. EDWARD H. WEATHERHEAD and THEODORE H. SCHUTT, Cleveland, Ohio.

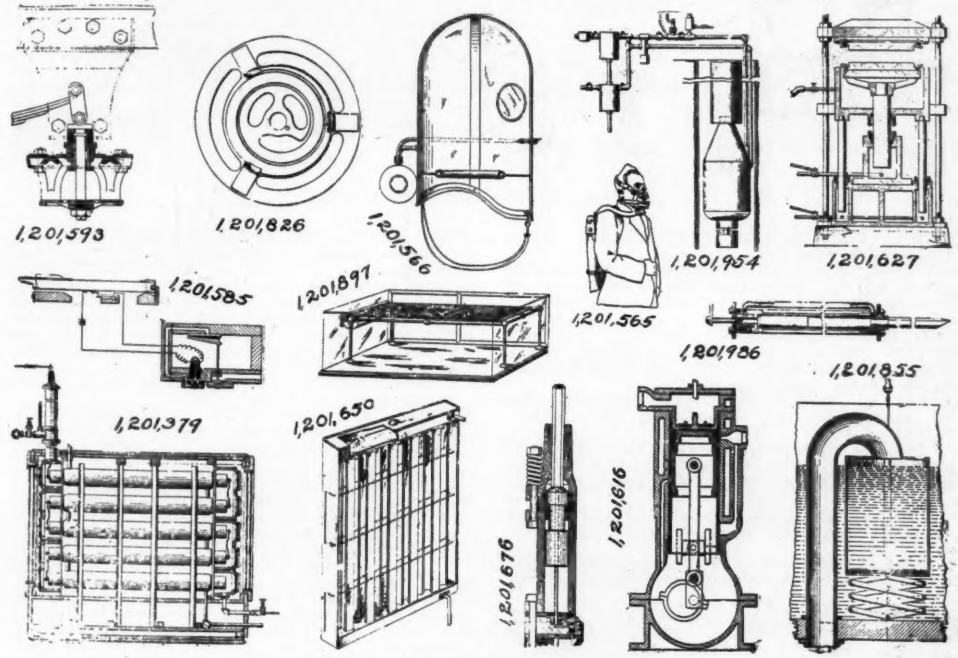
1,201,676. WATER-HEAD FOR FLUID-OPERATED PERCUSSIVE TOOLS. LEWIS C. BAYLES and ALBERT H. TAYLOR, Easton, Pa.

1,201,705. INTERCOOLER FOR AIR - COMPRESSORS. CHARLES DAY and GEORGE E. WINDELER, Stockport, England.

1,201,724. THROTTLE-VALVE FOR ROCK-DRILLING ENGINES. CHARLES C. HANSEN, Easton, Pa.

1,201,826-7. VALVE FOR BLOWING-ENGINES, &c. LORENZ IVERSEN, West Homestead, Pa.

1,201,855. SIPHON-VALVE. WILLIAM MUIR, New York, N. Y.



PNEUMATIC PATENTS OCTOBER 17.

OCTOBER 17.

1,201,306. PNEUMATIC ACTION FOR MUSICAL INSTRUMENTS. VERN L. JONES, Detroit, Mich.

1,201,379-80. APPARATUS FOR THE PRODUCTION OF OZONE. JAN STEYNIS, Bay Shore, N. Y.

1,201,565-6. RESCUE APPARATUS. ALFRED E. DAVIDSON, Newark, N. J.

1,201,585. ELECTROPNEUMATIC ORGAN-VALVE. ROBERT HOPE-JONES, North Tonawanda, N. Y.

1,201,593. PNEUMATIC SHOCK-ABSORBING DEVICE PARTICULARLY APPLICABLE TO VEHICLES. EDWARD BRICE KILLEN, London, England.

1,201,616. AIR - COMPRESSOR. HARLEIGH PARKHURST, Walpole, N. H.

1,201,627. PROCESS OF AND APPARATUS FOR REMOVING INFLATED ARTICLES FROM MOLDS. FRED THOMAS ROBERTS, Cleveland, Ohio.

1,201,647-8. METHOD OF AND APPARATUS FOR BALANCING AIRCRAFT. JOHN P. TARBOX, Washington, D. C.

1,201,897. AIR - MOISTENING APPARATUS. ROLAND WALLACE, Washington, D. C.

1,201,954. PUMP. CHARLES HENRY FOX, Bakersfield, Cal.

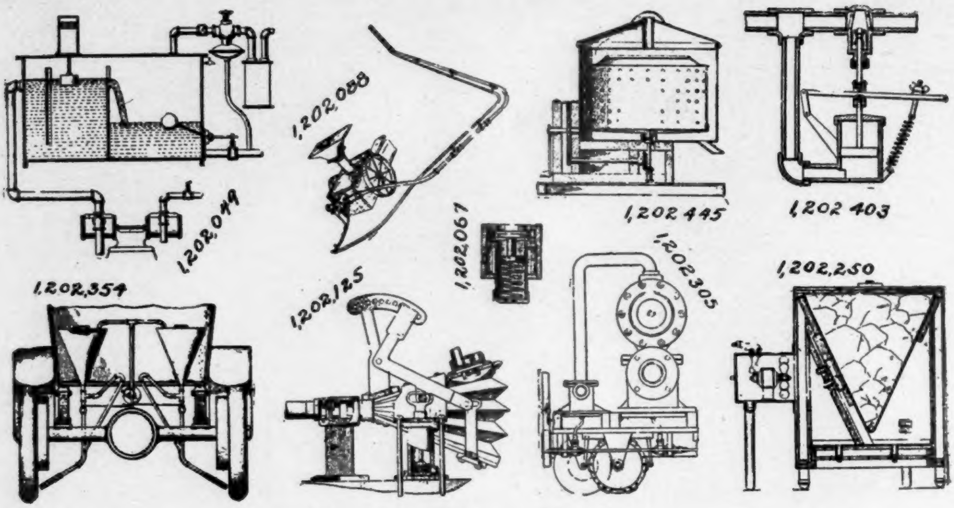
1. In an apparatus for raising water from wells or other places, a pump cylinder adapted to be immersed in the water, a reciprocatory piston in the pump cylinder provided with a valve controlled by the piston and in turn controlling the outlet of the pump cylinder, means for introducing an explosive mixture into the pump cylinder on the valve side of the piston, and means for supplying air under pressure to the pump cylinder on that side of the piston remote from the valve.

1,201,986. PNEUMATIC RIVET - BREAKER. STONEWALL J. SEDINGER, Indianapolis, Ind.

OCTOBER 24

1,202,049. LIQUID - MEASURING APPARATUS. JOSEPH W. GAMBLE, Philadelphia, Pa.

1,202,067. AUTOMATIC AIR-VALVE FOR EXPLOSIVE-MOTORS. CLAYTON HULSLANDER, Elmira, N. Y.



PNEUMATIC PATENTS OCTOBER 24.

1,202,088. PNEUMATIC CONVEYER. JOHN D. MURRAY, San Francisco, Cal.

1,202,125-6. APPARATUS FOR PRODUCING ARTIFICIAL REPIRATION. WILLIAM E. TULLAR, Chicago, Ill.

1,202,157. PNEUMATIC SPRING. ANDREW B. BURT, San Francisco, Cal.

1,202,250. APPARATUS FOR DEHUMIDIFYING, PURIFYING, AND COOLING AIR. LUKE USHER, Los Angeles, Cal.

1,202,258. AUTOMATIC AIR-COUPLING. IRA W. ARMSTRONG and CHARLES A. PLAMADORE, Belvidere, Ill.

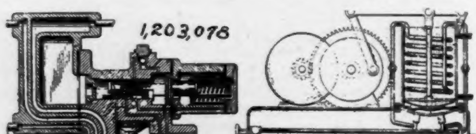
1,202,305. SOUND-PRODUCING DEVICE FOR FOG-SIGNALING, POSITION - LOCATING, AND THE LIKE. JOHN PELL NORTHEY, Toronto, Ontario, Canada.

1,202,354. ANTISKIDDING APPARATUS FOR AUTO-CARS, &c. WILLIAM C. BELL, Winnetka, Ill.

1. The combination with an auto-car or the like, of a sand-box supported thereby, a discharge-pipe leading downward therefrom, valve controlled means for introducing air-pressure into said sand-box, a valve in said discharge-pipe, devices extending into the body of said car for operating said valve, a system of pipes the ends of which are connected to said discharge-pipe and which make a detour around said valve, and means extending into the body of the car for operating said valve.

1,202,403. PRESSURE - REGULATOR. JOHN R. MILLER, San Dimas, Cal.

1,202,445. DRYING AND AERATING MACHINE. JONAS ALBERT SPARKS, Elk City, and LESLIE C. WATERS, Columbus, Kans.



PNEUMATIC PATENTS OCTOBER 31.

OCTOBER 31

1,202,864. REFRIGERATION-COMPRESSOR. WALTER R. MCGINNIS, St. Louis, Mo.

1,202,871. TRACK-SANDER. OTTO WILLIAM MEISSNER, Montreal, Quebec, Canada.

1. In a track sander, a pressure retaining sand box, a sand ejecting device, means for supplying air pressure to the sand ejecting device and building up a back pressure in the box and means for removing the back pressure at substantially the same instant that the air pressure is shut off from the sand ejecting device.

1,202,932. PUMP. ELMER A. WATTS, Springfield, Ohio.

1. In a mechanism for raising fluids, a pair of superimposed elongated chambers communicating with each other and provided with heads, a compressed air passage extending through the head of the upper chamber, a passage connecting the same with the lower head, exhaust passages in said heads, valve controlled portions in each head connecting the chambers with said compressed air and exhaust passages, compressed air means within each head for actuating the valves of the heads, and means in each chamber controlled by the rise and fall of fluid therein for actuating said compressed air means.

1,203,024. PNEUMATIC WHEEL. ELI C. MCCARTEY, Littleton, Ill.

1,203,078. FLUID-PRESSURE BRAKE APPARATUS. WALTER V. TURNER, Edgewood, Pa.

1,203,284. ROCK-DRILL. DANIEL S. WAUGH, Denver, Colo.

1,203,335. AIR-COMPRESSOR. STIRLING B. HILL, Seattle, Wash.

1,203,401. PNEUMATIC PIANO-PLAYER ACTION. JOSEPH POSPISIL, Newark, N. J.

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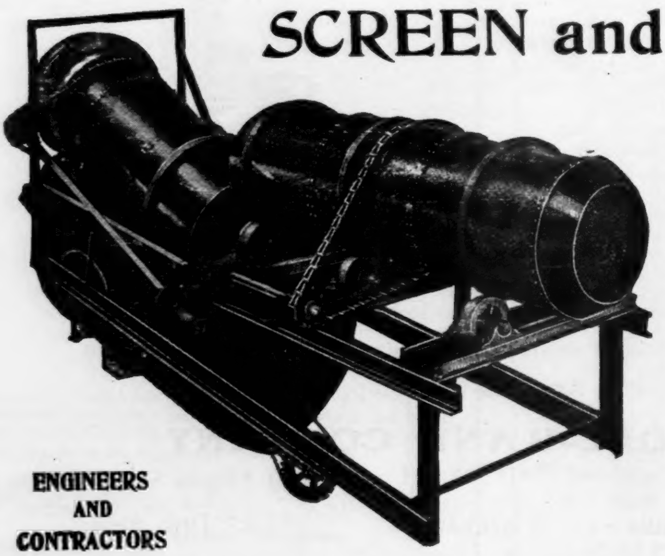

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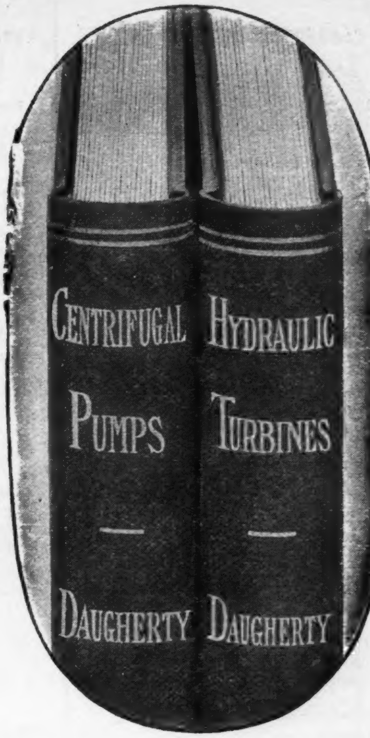

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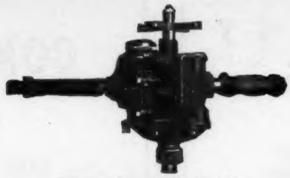

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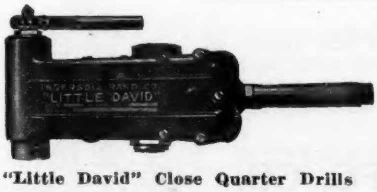

"Little David" Close Quarter Drills

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